UNDERSTANDING FREQUENT EMERGENCY DEPARTMENT USE IN THE MEDICARE POPULATION

by
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ABSTRACT

Frequent emergency department (ED) use, defined as 4 or more visits to the ED in a calendar year, is a significant public health concern. Despite the fact that Medicare beneficiaries are twice as likely as the privately insured to be frequent ED users, there is little known about the risk factors for frequent ED use in this population. This dissertation sought to gain an understanding of frequent ED use in the Medicare population using the Andersen model of health service utilization as a framework. I conducted a literature review of scholarly articles on frequent ED use, a cross-sectional analysis of frequent ED use in 2010, and a longitudinal analysis of frequent ED use across 2009 and 2010 using a 20% sample of Medicare beneficiaries.

I found that frequent ED use is a rare and temporary phenomenon in the Medicare population. While frequent ED use in 2009 is the strongest predictor of frequent ED use in 2010, most frequent users will regress to infrequent or non-ED use in the subsequent year. Both the cross-sectional and longitudinal analyses indicated that younger age, African-American race, Medicaid eligibility, diagnoses of chronic disease or mental illness, high utilization of physician office visits, and low continuity of care are associated with greater relative risk of frequent ED use in 2010. My findings suggest that an integrated approach to treating young, disabled Medicare beneficiaries and those with chronic disease and mental illness is needed.

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Introduction

The emergency department (ED), though a necessary resource in the US healthcare system, is not typically the most patient-centered and efficient locus of care. The average patient in the US can expect to wait nearly an hour to see a physician in the ED.[1] ED patients are also at risk for undergoing redundant testing and receiving inappropriate medications. Approximately 40% of adults aged 18-64 and 60% of the elderly have x-rays, CT scans, or MRIs conducted during their ED visit.[1] Additionally, 25% of adults aged 18-64 and 15% of the elderly will be prescribed narcotics and 19% and 16%, respectively, will have antibiotics administered.

Emergency departments have become increasingly strained and costs for patients and insurers have risen dramatically in the past decade. Between 1998 and 2008, the number of hospital-based EDs shrunk by 3.3%, while the volume of ED visits increased by 30%.[2] According to 2010 Medical Expenditure Panel Survey, the mean total cost for an ED visits was $1,097 for adults aged 18-64 and $1,062 for adults aged 65 and older, up from $539 and $720, respectively in 2000.[1]

Frequent ED use is a significant public health concern, particularly in the context of an overly burdened ED system. Despite representing only 8% of ED patients, people who use the ED 4 or more times in one year (frequent ED users) account for 28% of all ED visits in the US.[3],[4] Frequent ED users are more likely than infrequent ED users to arrive by ambulance and to be admitted to the hospital; once in the hospital, they stay for longer periods of time.[3],[5],[6] Furthermore, frequent ED users are more likely to die when they present to the ED.[6],[7] Frequent ED users are a resource-intensive population; they rely heavily on a range of services such as physician and hospital care.[3],[4],[7]

The topic of frequent ED use is especially pertinent to the Medicare program. Medicare beneficiaries are nearly twice as likely as privately insured individuals to be frequent ED users.[4] ED visits are particularly hazardous events for older adults, who represent the majority of the Medicare population, as they may precipitate a cascade of adverse events such as hospitalization, readmission, nursing home placement, and death.[8] Identifying factors associated with frequent ED use in the Medicare population might contribute knowledge that could be used to improve healthcare quality and reduce avoidable costs. This dissertation seeks to provide a thorough description of frequent ED users in Medicare and to determine predictors of frequent ED use, with a particular emphasis on individual and contextual measures of primary care.

This dissertation is organized into chapters as follows. Chapter 1 reviews scholarly literature on frequent ED use and discusses gaps in the research that motivated my interest in this topic. Chapter 2 presents the methodology used to define and identify frequent ED use, data sources that were used, construction of study variables, and the approach to the analysis. Chapter 3 includes my first independent study, a cross-sectional examination of frequent ED use in Medicare in 2010. Chapter 4 describes my second original research project, a longitudinal examination of frequent ED use in Medicare across 2009 and 2010. Both studies rely on a 20% of Medicare beneficiaries from the Chronic Condition Data Warehouse (CCW) and other linked files. The final chapter presents a discussion of my findings along with recommendations for policy actions and directions for future research.

Chapter 1: Manuscript 1

Understanding Frequent Emergency Department Use in the Medicare Population: A Review of the Literature

ABSTRACT

Context: Frequent emergency department (ED) use is of clinical relevance to Medicare beneficiaries and practical interest to health care providers and insurers. Little is known about risk factors for frequent ED use in this population.

Objective: We sought to gain an understanding of individual and contextual factors associated with frequent ED use that may have relevance for Medicare beneficiaries.

Study Design: We conducted a targeted search on PubMed to find scholarly articles written in the past 20 years that evaluated frequent ED use, defined as 4 or more ED visits in a calendar year. We synthesized study findings and evaluated gaps in the literature.

Principle Findings: We identified 22 studies describing frequent ED use. Risk factors that are positively associated with frequent ED use include age (7 of 16 studies), race (7 of 7 studies), lower educational attainment (3 of 5 studies), public insurance (9 of 10 studies), usual source of care (3 of 3 studies), heavy utilization of physician and hospital services (7 of 7 and 6 of 6 studies, respectively), worse self-reported physical health (4 of 5 studies), and diagnoses of chronic disease (10 of 10 studies) and mental health or substance abuse disorders (10 of 11 studies). Income (5 of 5 studies), employment (4 of 5 studies), distance from the ED (3 of 3 studies), and private health insurance (9 of 9 studies) appear to be inversely associated with frequent ED use. Factors that were not significant or appeared to have mixed association with frequent ED use include gender, marital status, managed care, and having a primary care provider. More research is needed to understand frequent ED use

specifically in the Medicare population, the role of access to and quality of primary care in frequent ED use, and the persistence of frequent ED use over time.

Conclusion and Policy Implications: While there is extensive research on frequent ED use in the general population, further investigation is needed, particularly on modifiable factors, to inform interventions to reduce frequent ED use in Medicare beneficiaries.

Introduction and Orientation to the Policy Problem

Emergency department (ED) visits are a major public health concern. ED visits are hazardous events, especially for older adults who may experience hospitalization, readmission, nursing home placement, and death.[8] Additionally, the average emergency department visit expenditures in the US exceed $1,200, far more than what most Americans pay for housing per month.[9] Reducing ED visits is therefore of practical significance to both the quality and efficiency of healthcare.

Frequent ED users are a disproportionately vulnerable and costly group. Despite representing only 8% of ED patients, people who use the ED 4 or more times in one year (from this point on referred to as, "frequent ED users") account for 28% of all ED visits in the US.[3,4] Frequent ED users are more likely than infrequent ED users to arrive by ambulance and to be admitted to the hospital; once in the hospital, they stay for longer periods of time.[3,5,6] Frequent ED use is even more problematic in a climate of hospital closings and ED overcrowding. Between 1998 and 2008, the number of hospital-based EDs shrunk by 3.3%, while the volume of ED visits increased by 30%.[2]

The topic of frequent ED use is especially relevant to recent Medicare efforts to identify innovative approaches that improve both health care quality and efficiency. Because Medicare beneficiaries are nearly twice as likely as privately insured individuals to be frequent

ED users, the lack of information regarding frequent ED use in this population represents an important evidence gap.[4] Identifying factors associated with frequent ED use in the Medicare population may contribute knowledge that in turn can be used to improve healthcare quality and reduce avoidable costs. We sought to identify and synthesize previous published studies to determine the strength of existing evidence regarding frequent ED use among Medicare beneficiaries.

Methodology

In order to better understand the issue of frequent ED use in the Medicare population, we conducted a literature review of peer-reviewed studies that have been published on this topic. We used the National Library of Medicine's PubMed engine to search for scholarly articles pertaining to frequent ED use. Our first criterion was that the terms "frequent users" AND "emergency department", "frequent users" AND "emergency room", "frequent attenders" AND "emergency department", OR "frequent attenders" AND "emergency room" were in the abstract or title. We also required that articles be published in English and in the last 20 years. We identified 85 unique studies for which we further reviewed titles and abstracts to determine eligibility for this study. Specifically, we sought reports from original research or systematic reviews of the literature that established the prevalence of, and factors associated with, frequent ED use rather than editorials or evaluations of interventions. A total of 38 articles met these criteria. Because measures of frequent ED use varied widely, we sought to first identify a common definition to guide our synthesis and interpretation of the evidence.

In a 2010 systematic review, LaCalle and Rabin conclude that there is no universally accepted standard of what constitutes frequent ED use.[3] They found definitions of frequent ED use that ranged from 2 to 12 visits in a calendar year and observed that investigators

generally weigh the sensitivity of a measure in capturing the population of interest against the specificity of defining a group that can be targeted for intervention. LaCalle and Rabin advocate for a cutoff of 4 or more visits in a calendar year, which they found to be the most commonly used in the literature.

Not only is 4 ED visits the most commonly used benchmark for indicating frequent ED use, the definition has been found to have empirical justification. Hunt and colleagues (2006) argue that frequent ED use "should be defined according to the size and impact of this group of patients."[4] They reasoned that persons accounting for a disproportionate share of ED incidents would be an appropriate target for intervention, and that focusing on a group that represents 25% of ED events would likely have a substantive impact on the total number of ED visits. Using a sample of 49,603 adults from the Community Tracking Survey, they reported that 8% of participants who reported 4 or more ED incidents accounted for 28% of total reported ED visits.

Locker and colleagues' work further supports a threshold of 4 or more visits to define frequent ED use.[10] They projected a theoretical distribution of ED visits if events were random and compared it to an empirical distribution of actual ED visits in the UK. At 4 visits, the observed frequency flattened at around 1000 on a logarithmic scale, deviating significantly from the expected distribution, which continued a steep decline. The results suggested that persons who incur 4 or more ED visits are different than the general population and their visits cannot be attributed to chance. The authors found that 99.99% of "chance attenders" would be expected to present to the ED less than 4 times per year.

Therefore, given this background, we further refined our literature review strategy to focus on articles that defined frequent ED use as 3, 4, or 5 visits in a calendar year. We did this in order to retain the most studies possible in our analysis while maintaining

comparability across the studies. Of the 38 initially identified articles, 16 met this additional inclusion criterion. We also examined references listed in each of the 16 originally identified articles using a snowball approach. If any related or referenced article title was relevant, we looked at its abstract to see if it met the criteria of being focused on the factors influencing frequent ED use, defined as 3-5 visits in a calendar year, and were published in English in the last 20 years. If the article was eligible for inclusion, we reviewed its references and so on until we reached a saturation point wherein no additional scholarly articles were identified.

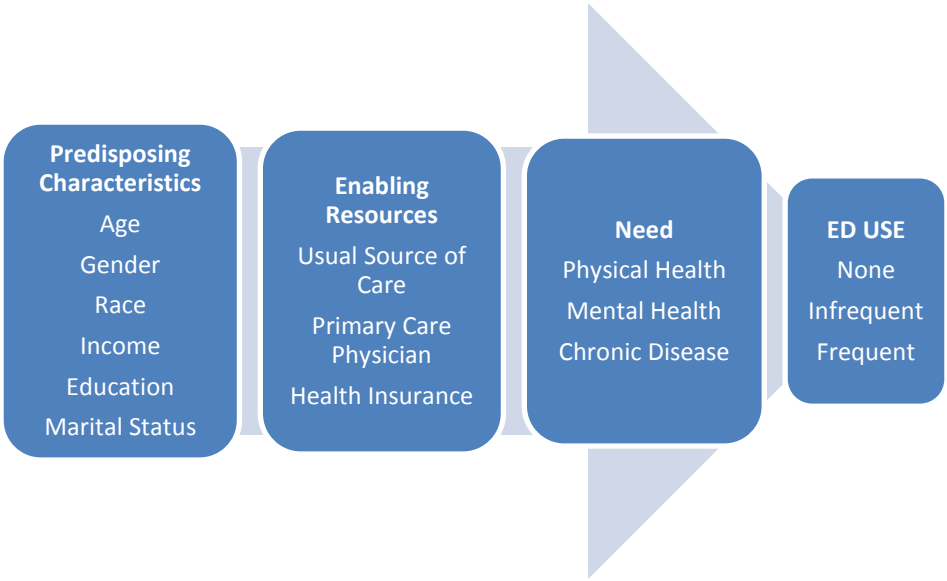
Ultimately we identified 22 articles – 20 original studies, 1 systematic review, and 1 expert consensus – for inclusion in this review. For each of the 22 articles identified, we extracted pertinent information, including the year of publication and data regarding the study sample characteristics, setting, study design, sample size, the metric used to define frequent ED use, and reported prevalence of frequent ED use. For each of the 20 original studies, we compiled a list of all variables that were examined in relation to frequent ED use. We then extracted information regarding statistical significance and direction of association between each variable and the outcome of frequent ED use by article. Finally, we examined the systematic review and expert consensus in relation to the results of our review to identify gaps in the literature on frequent ED use that warrant further research.

Conceptual Framework

Our literature review draws from the theoretical basis of Andersen's framework, which explains health services use as the interrelationship among predisposing characteristics, enabling resources, and need (see Figure 1).[11] Need, both perceived and evaluated, is the immediate reason that individuals seek healthcare, and the most proximate determinant of health service utilization. Predisposing factors, such as socio-demographic

characteristics and health beliefs, determine individual risk for developing an illness or injury (need), and enabling resources, such as community services and access to primary care, facilitate or inhibit the seeking of medical services to address needs. When need is the primary determinant of health service utilization, rather than predisposing characteristics or enabling resources, access to services is assumed to be equitable. Conversely, if predisposing characteristics and enabling resources explain more variance in health service utilization, it suggests inequity in access and quality. Other authors have applied this model to explain ED utilization, and we do so here to conceptualize the pathway by which individual and contextual factors result in frequent ED use.[12,13] Below we summarize the main findings from our review of the literature on frequent ED use, using Andersen's framework to guide the discussion.

Figure 1: Conceptual Framework



Results

The 22 articles we reviewed are summarized in Table 1. Of the 20 original research articles we identified, 16 examined convenience samples of patients presenting to one ED or hospital system, 2 examined statewide hospital databases, and 2 examined national surveys.

Because the majority of the studies were restricted to one hospital, frequent ED users were most often compared to infrequent ED users. Only 2 articles included comparisons of frequent and non-ED users. The majority of studies had predominantly younger or middle-aged adult subjects, and none focused on older adults. Only one study used a representative sample of the US population. The 20 studies examined were located in a variety of geographic regions, with 11 in the US and the remaining 9 in foreign countries. While 12 of the 20 papers included regression analysis, the others only reported descriptive results.

Half of the articles used 4+ visits as a cutoff to define frequent ED use, 6 used 3+ and 4 used 5+ visits. The prevalence of frequent ED use varied from 1% to 32%, with a mode of roughly 3%. It is unclear why one study conducted in Saudi Arabia on a sample of adults at a public hospital observed a rate of frequent ED use as high as 32%. However, this result appeared to be an outlier as the remaining studies found rates at or less than 12%.

Using our conceptual framework to orient findings, measures were organized by predisposing, enabling, and need characteristics. All factors that were explored in at least 3 of the articles were summarized and charted across the studies. Few of the identified articles comprehensively examined a wide range of predisposing socio-demographic factors, enabling factors that relate to challenges to access and quality at the healthcare system level, and need, based on clinical measures of health status (Table 2). Age, gender, insurance, and health conditions were most consistently examined in relation to frequent ED use, whereas measures of access and quality of care were least studied (Table 3).

Predisposing Characteristics

Predisposing characteristics were mixed in their relationship to frequent ED use. In terms of age, 7 of the 16 articles that examined age found it to be positively associated with frequent ED use, 3 reported mixed results, 6 found no relationship, and no studies

Table 1: Summary of Articles Reviewed

Authors	Year	Type of Study	Setting	Study Population/Sampling Frame	Sample Size	Definition of Frequent ED Use	Prevalence of Frequent ED Use	Reference Group	Type of Analysis
Alghanim and Alomar[14]	2011	Observational	Public hospital in Riyadh, Saudi Arabia	All adults presenting to the ED	666	3+ visits/year	31.80%	Infrequent ED Users	Regression
Bieler et al.[15]	2012	Observational	Teaching hospital in Lausanne, Switzerland	All adults presenting to the ED (Mean age~45)	719	4+ visits/year	4.40%	Infrequent ED Users	Regression
Blank et al.[16]	2005	Observational	Urban teaching hospital in Massachusetts	All adults presenting to the ED, most aged 18-65	66,552	4-11 visits/year (moderate); 12+ (high)	6.00%	Infrequent ED Users	Descriptive
Byrne et al.[17]	2003	Observational	Urban teaching hospital in Dublin, Ireland	100 frequent ED users and matched controls (Mean ages 57, 53)	200	4+ visits/year	3.10%	Infrequent ED Users	Descriptive
Cook et al.[18]	2003	Observational	Statewide database of hospitals in Utah	All adults presenting to EDs in Utah, mean age 25	771,527	5+ visits/year	4.51%	Infrequent ED Users	Descriptive
Fuda and Immekus[6]	2006	Observational	Statewide database of hospitals in Massachusetts	All Massachusetts residents presenting to the ED compared to general population in Massachusetts	1,684,834	5+ visits/year	3.80%	Infrequent ED Users and Non-ED Users	Descriptive

Authors	Year	Type of Study	Setting	Study Population/Sampling Frame	Sample Size	Definition of Frequent ED Use	Prevalence of Frequent ED Use	Reference Group	Type of Analysis
Hansagi et al.[7]	2001	Observational	Public hospital in Stockholm, Sweden	All patients presenting to the ED, most aged 15-45	47,349	4+ visits/year	4.00%	Infrequent ED Users	Regression
Huang et al.[12]	2003	Observational	Suburban teaching hospital in Taichung, Taiwan	All patients presenting to the ED aged 15 and older	800	4+ visits/year	3.50%	Infrequent ED Users	Regression
Hunt et al.[4]	2006	Survey	Community Tracking Survey, US	Representative sample of US adults	49,603	4+ visits/year	8.00%	Infrequent ED Users	Regression
Kirby et al.[19]	2010	Observational	Regional hospital in NSW Australia	All patients presenting to the ED, mean age 39 for infrequent and 66 for frequent ED users	15,806	Readmitted to hospital 3+ times/year	1.00%	Infrequent ED Users	Regression
LaCalle and Rabin[3]	2010	Systematic Review	N/A	N/A	N/A	4+ visits/year	4.5-8.0%	N/A	N/A
Locker et al.[10]	2007	Observational	2 urban hospitals in the UK	All patients presenting to the ED, mean age 44.5 for infrequent and 49.7 for frequent ED users	75,141	4+ visits/year	3.70%	Infrequent ED Users	Descriptive
Lucas and Sanford[20]	2008	Observational	George Washington University Medical Center	Sample of frequent ED users compared to general ED population, mean age 44	6,523	2 visits/past month or 4+ visits/past year	2.10%	Infrequent ED Users	Descriptive
Mandelberg, Kuhn and Kohn[21]	2000	Observational	San Francisco General Hospital	All patients presenting to the ED, most aged 30-59	43,383	5+ visits/year	3.90%	Infrequent ED Users	Regression

Authors	Year	Type of Study	Setting	Study Population/Sampling Frame	Sample Size	Definition of Frequent ED Use	Prevalence of Frequent ED Use	Reference Group	Type of Analysis
Moe et al.[22]	2013	Observational	Suburban ED in Alberta, Canada	All adults presenting to the ED	14,223	5+ visits/year	3.10%	Infrequent ED Users	Descriptive
Paul et al.[23]	2010	Observational	General hospital in Singapore	All patients presenting to the ED, most aged 25-44	82,172	5+ visits/year	1.90%	Infrequent ED Users	Regression
Pines et al.[24]	2011	Literature Review/ Expert Consensus	N/A	N/A	N/A	4+ visits/year	N/A	Infrequent ED Users	Descriptive
Okuyemi and Frey[25]	2001	Observational	University of Kansas Medical Center	All adults presenting to the ED, most age 25-44	12,258	3+ visits/year	Unknown	Infrequent ED Users	Regression
Ruger et al.[5]	2004	Observational	Urban teaching hospital in the US	All patients presenting to the ED, mean age 43	71,941	3+ visits/year	12.30%	Infrequent ED Users	Regression
Sandoval et al.[26]	2010	Observational	University of Chicago Medical Center	All adults presenting to the ED, mean age 38 for infrequent and 45 for frequent ED users	49,000	3+ visits/year	7.00%	Infrequent ED Users	Descriptive
Sun, Burstin, and Brennan[27]	2003	Observational	5 urban teaching hospitals in the US	All patients presenting to the ED, most aged 19-39	2,899	4+ visits/year	8.20%	Infrequent ED Users	Regression
Zuckerman and Shen[28]	2004	Survey	National Survey of American Families, US	Nationally representative sample of adults age 18-64	89,626	3+ visits/year	3.00%	Non-ED Users	Regression

Table 2: Summary of Factors Associated with Frequent ED Use in Literature Review

	Alghanim and Alomar	Bieler et al.	Blank et al.	Byrne et al.	Cook et al.	Fuda and Immekus	Hansagi et al.
Predisposing Characteristics							
Age (Older)	+	0	+/-	0	0	+/-	+
Gender (Female)		0	+	0	+/-	+	0
Race (Minority)	NS	NS	+	NS	NS	+	NS
Income	NS	NS	NS	NS	NS	NS	NS
Education	0	NS	NS	NS	NS	NS	NS
Employment (Employed)	+	–	–	NS	NS	NS	NS
Marital Status (Married)	0	–	NS	0	NS	NS	NS
Enabling Resources							
Greater Distance Travelled to ED	–	–	NS	NS	NS	NS	NS
Public Insurance	NS	NS	+	NS	+	+	NS
Private Insurance	NS	NS	-	NS	–	–	NS
Managed Care	NS	NS	NS	NS	NS	NS	NS
Usual Source of Care	NS	NS	NS	NS	NS	NS	NS
Primary Care Provider	0	–	+	NS	NS	NS	NS
Continuity of Care	NS	NS	NS	NS	NS	NS	NS
Other Utilization - Physician Visits	+	NS	NS	+	NS	NS	+
Other Utilization - Hospitalizations	+	+	NS	+	NS	NS	+
Need							
Poor Self-Reported Physical Health	NS	NS	NS	NS	NS	NS	NS
Poor Self-Reported Mental Health	NS	NS	NS	NS	NS	NS	NS
Chronic Disease Diagnoses	+	NS	NS	NS	+	+	NS
Mental Health/Substance Abuse Diagnoses	NS	+	NS	+	+/-	+	NS
Higher Triage Status	NS	NS	NS	0	NS	NS	NS
Control Variables	Nationality, usual transportation used	Under guardianship, Use of 5+ clinical departments	N/A	N/A	N/A	N/A	Use of hospital outpatient department, Hospital length of stay

	Huang et al.	Hunt et al.	Kirby et al.	Locker et al.	Lucas and Sanford	Mandelberg, Kuhn and Kohn	Moe et al.
Predisposing Characteristics							
Age (Older)	+	NS	+	+	NS	+/-	0
Gender (Female)	0	+	0	0	0	–	0
Race (Minority)	NS	+	NS	NS	+	+	NS
Income	–	–	NS	NS	NS	NS	NS
Education	–	NS	NS	NS	NS	NS	NS
Employment (Employed)	–	NS	NS	NS	NS	NS	NS
Marital Status (Married)	–	NS	NS	–	NS	NS	NS
Enabling Resources							
Greater Distance Travelled to ED	NS	NS	NS	NS	NS	NS	NS
Public Insurance	NS	+	NS	NS	+	+	NS
Private Insurance	NS	–	NS	NS	–	–	NS
Managed Care	NS	0	NS	NS	0	NS	NS
Usual Source of Care	+	+	NS	NS	NS	NS	NS
Primary Care Provider	NS	NS	NS	NS	NS	NS	NS
Continuity of Care	NS	–	NS	NS	NS	NS	NS
Other Utilization - Physician Visits	+	+	NS	NS	NS	NS	NS
Other Utilization - Hospitalizations	+	NS	NS	NS	NS	NS	NS
Need							
Poor Self-Reported Physical Health	+	+	NS	NS	NS	NS	NS
Poor Self-Reported Mental Health	NS	+	NS	NS	NS	NS	NS
Chronic Disease Diagnoses	+	NS	+	NS	NS	+	+
Mental Health/Substance Abuse Diagnoses	+	NS	+	+	NS	+	+
Higher Triage Status	–	NS	+	NS	NS	–	0
Other Control Variables (Regression Analysis Only)	Satisfaction with treatment outcome	Change in usual source of care, patient satisfaction, self-report of unmet needs	28-day readmission	N/A	N/A	Homelessness	N/A

	Paul et al.	Okuyemi and Frey	Ruger et al.	Sandoval et al.	Sun, Burstin, and Brennan	Zuckerman and Shen
Predisposing Characteristics						
Age (Older)	+	0	0	+	NS	NS
Gender (Female)	–	0	+/-	–	NS	NS
Race (Minority)	NS	NS	NS	+	NS	+
Income	NS	NS	NS	–	–	–
Education	NS	NS	NS	0	–	–
Employment (Employed)	NS	NS	NS	–	NS	NS
Marital Status (Married)	NS	0	NS	0	–	0
Enabling Resources						
Greater Distance Travelled to ED	–	NS	NS	NS	NS	NS
Public Insurance	NS	0	+	+	NS	+
Private Insurance	NS	NS	–	–	NS	–
Managed Care	NS	NS	–	NS	NS	–
Usual Source of Care	NS	NS	NS	NS	+	NS
Primary Care Provider	NS	NS	NS	NS	+	NS
Continuity of Care	NS	NS	NS	NS	NS	NS
Other Utilization - Physician Visits	NS	NS	NS	NS	+	+
Other Utilization - Hospitalizations	NS	NS	NS	NS	+	NS
Need						
Poor Self-Reported Physical Health	NS	NS	NS	+	0	+
Poor Self-Reported Mental Health	NS	NS	NS	+	NS	NS
Chronic Disease Diagnoses	+	NS	NS	+	+	NS
Mental Health/Substance Abuse Diagnoses	NS	NS	NS	+	+	NS
Higher Triage Status	0	NS	+	NS	+	NS
Other Control Variables (Regression Analysis Only)	Day and time of attendance	Prior ED use	Day, Time, and Mode of Arrival	N/A	Household composition, language, severity score, self-reported reason for visiting ED	Citizenship, family structure, disability

Table 2 Key
+: Positive Association
-: Negative Association
+/-: Mixed Relationship
0: No relationship
NS: Not Studied

Table 3: Summary of positive (+), negative (-), mixed (+/-) and null findings					
	n	**+**	**-**	**+/-**	**0**
Predisposing Characteristics					
Age (Older)	16	7	0	3	6
Gender (Female)	18	3	4	2	9
Race (Minority)	7	7	0	0	0
Income	5	0	5	0	0
Education	5	0	3	0	2
Employment (Employed)	5	1	4	0	0
Marital Status (Married)	9	0	4	0	5
Enabling Resources					
Public Insurance	10	9	0	0	1
Private Insurance	9	0	9	0	0
Managed Care	4	0	2	0	2
Usual Source of Care	3	3	0	0	0
Primary Care Provider	4	2	1	0	1
Distance to ED	3	0	3	0	0
Other Utilization - Physician Visits	7	7	0	0	0
Other Utilization - Hospitalizations	6	6	0	0	0
Need					
Poor Self-Reported Physical Health	5	4	0	0	1
Chronic Disease Diagnoses	10	10	0	0	0
Mental Health/Substance Abuse Diagnoses	11	10	0	1	0
Triage Status	8	3	2	0	3

reported an inverse association. For instance, in an analysis of claims from all non-federal acute-care hospitals in Massachusetts, Fuda and Immekus found a bimodal distribution in frequent ED use, defined as 5 or more visits annually, with increased prevalence in patients aged 25-44and older than 65.[6] Findings are also mixed with respect to gender. Men were more likely than women to be frequent ED users in 4 of 18 articles, whereas 3 studies reported women to be more likely to incur frequent ED use, 2 studies reported mixed results, and 9 studies reported no relationship between gender and frequent ED use.

Being married was inversely associated with frequent ED use in 4 of 9 studies, 5 studies did not observe a statistically significant association between marital status and frequent ED use, and no studies reported being married to be positively associated with frequent ED use. Minority race was consistently associated with frequent ED use; 7 of 7 studies that examined race reported African-Americans and/or Hispanics to be more likely to incur frequent ED use. Income was consistently inversely related to frequent ED use in 5 of 5 studies. Education was inversely related to frequent ED use in 3 studies, but 2 studies found no significant relationship. Being unemployed was associated with frequent ED use in 4 of the 5 studies reporting this measure.

Health System/Primary Care Factors (Enabling Resources)

One common misconception about frequent ED users is that they lack insurance or a usual source of care, and thus depend on the emergency room for routine primary care. However in 9 out of 10 studies that looked at insurance status and frequent ED use, patients with public insurance such as Medicare and Medicaid were the most likely to be frequent ED users. Those with private insurance were the least likely (9 out of 10 studies), and those with no insurance were either similarly or less likely than those with public insurance to be frequent ED users. All 3 studies that examined usual source of care found frequent ED

users were more likely to have a usual source of care. Managed care was negatively associated with frequent ED use in 2 studies, but 2 other studies found no relationship.

The relationship between having a primary care physician and frequent ED user was mixed; 1 in 4 studies reported an inverse relationship, 2 studies reported a positive relationship, and 1 study reported no relationship. Sun, Burstin and Brennan found that frequent ED users were more likely to have visited a PCP in the previous month.[27] Interestingly, respondents of the Community Tracking Study Household Survey who reported seeing the same physician at every primary care visit had 33% lower odds of frequent ED use.[4] However this was the only study that addressed continuity of care in any form. Heavy use of physician visits (7 of 7 studies) and hospital inpatient visits (6 of 6 studies) were significantly related to frequent ED use.

Few articles explicitly addressed access to care with respect to frequent ED use. Three studies looked at the distance to the ED from the patient's home address, all of which found that frequent ED users tend to live closer to EDs. Hunt and colleagues (2006) asked survey respondents if they had forgone or delayed needed care in the past year, and frequent ED users were more likely to respond "Yes". Frequent users are also had lower rates of satisfaction with the medical care they received in the past year.

Clinical Factors (Need)

Clinical factors were consistently associated with frequent ED use. Poor self-rated physical health (4 of 5 studies) was positively associated with frequent ED use. Chronic disease (10 of 10 studies) and mental health or substance abuse diagnoses (10 of 11 studies) were widely studied and consistently found to be strong predictors of frequent ED use. There was no clear relationship between a patient's triage status when arriving to the ED and whether or not the patient was a frequent ED user. Frequent ED users were more likely to

present at a higher triage category in 3 studies, but 2 other studies found just the opposite and another 3 papers reported no association.

Discussion

Sociodemographic, health system, and clinical factors are all associated with frequent ED use. Minority race, low income and educational attainment, public insurance, a usual source of care, living close to an ED, high utilization of outpatient healthcare resources, and poor physical and mental health are all associated with greater odds of frequent ED use. Findings on gender, marital status, and primary care providers are mixed, while continuity of care and access to care are underexplored in the literature. Frequent ED users are not relying on the ED for primary care, as commonly believed. They are generally sicker, more socially vulnerable patients that are high utilizers across the continuum of healthcare.

While research on frequent ED use has been an area of active inquiry, several gaps in the literature warrant further investigation. First, broader population-based studies are needed, particularly of Medicare beneficiaries. The majority of studies to date rely on convenience samples, and the few larger scale studies that have been conducted do not include representative samples of older adults. In their systematic review of literature on frequent ED use, LaCalle and Rabin call for studies focused on the Medicare population, noting that "the elderly sick represent a large burden of visits, the extent of which is poorly defined."[3] There is also a lack of research conducted in the United States. Almost half of the studies we analyzed took place in other countries with healthcare systems vastly different than that in the US.

Second, there is a dearth of studies that observe ED use over a time period longer than a year. In a recently published literature review and expert consensus, Jesse Pines and colleagues specifically mentioned the need for longitudinal studies to identify patients that

will remain frequent ED users.[24] A person who is considered a frequent ED user in one year may not necessarily be a frequent ED user the following year. Mandelberg and colleagues examined frequent ED use across 3 years of time.[21] They found that among frequent ED users in one calendar year, the probability of continued frequent ED use was 37.9% in the following year. After 2 years of frequent ED use, the probability of continued frequent ED use in year 3 was 56.1%. Only 3.9% of subjects were frequent ED users in all 3 years. Cook et al observed similar trends in a statewide analysis of ED claims from 1996-1998 in Utah, finding that only 5% of participants were frequent ED users in all 3 study years.[18] Fuda and Immekus noticed regression to the mean in frequent ED users, with most returning to infrequent or non-ED use the subsequent year.[6]

As Pine et al. note, a person may have several ED visits at the time they experience an acute injury or illness, but then rarely if ever use the ED again for the remainder of the year or in the subsequent year. These users may be substantively different from what Mandelberg and colleagues refer to as "chronic" users who visit the ED frequently in 2 more consecutive years. Mandelberg's team calls for interventions focused on patients with "chronic" frequent ED use, as these patients may have substantial needs that are not being met in primary care. LaCalle and Rabin echo this argument for directing efforts toward "chronic frequent users: those who are not lost by predicted attrition and for whom intervention may be more effective." However no study to date has attempted to differentiate short-term from persistent frequent ED users to understand differences in underlying medical needs, reasons for visiting the ED, or potentially modifiable factors pertinent to interventions designed to reduce frequent ED use.

A further challenge noted by Pines and colleagues is that "the degree to which suboptimal primary care management leads to frequent ED use has not been well

explored."[24] The study by Hunt et al. was the only one we found in our review that addressed primary care beyond simply indicating usual source of care and primary care provider by looking at usual provider continuity and unmet need. If reducing reliance on the ED and hospital is the public health goal, it reasons that treating patients more appropriately and adequately in outpatient settings would lead to fewer acute care visits.

Researchers have often used continuity of care measures to evaluate the degree of fragmentation in outpatient care, an issue of particular importance to older adults with multimorbidity.[29] Only one study explored continuity of care in relation to frequent ED use. While research that links primary care to frequent ED use is sparse, findings from the literature general emergency room use do provide some insight as to the potential protective benefit of adequate access to primary care. In two studies of ED use among older adults, having a PCP who is a generalist as opposed to a specialist and having high continuity of care with PCPs appeared to be protective.[30,31] High continuity of care was also associated with lower ED utilization in a population-wide study in Tawain.[32] Gill, Mainous and Nsereko investigated ED use among Medicaid beneficiaries in Delaware. [33] In a multinomial logistic regression that examined outcomes of no ED visits, 1 ED visit, and multiple ED visits, high continuity of care was associated with lower odds of any ED visits and even more strongly with lower odds of multiple visits. The implication of these findings is that continuity of care may also be associated with frequent ED use.

Another gap in the literature on ED use we observed is that no articles have explored access to primary care in terms of the supply of physicians or other community-based primary care resources. Hunt's study was the only one on the topic of frequent ED use that looked at access to care beyond the presence of insurance and a primary care physician or distance to the ED. The supply of physicians and community health centers,

which may be alternatives to the ED, has not been studied with respect to frequent ED use. There has been some study of the association between physician supply and ED utilization in general which suggest that greater availability of physicians may be protective. [34,35] Exploring the correlation between physician supply and frequent ED use is of critical relevance given current health reform efforts to strengthen the primary care physician workforce.[36]

Lastly, the research on frequent ED use could benefit from more rigorous study designs. Only 12 of the studies we reviewed included regression-based analysis. The remaining articles contained descriptive statistics, which do not account for other variables that could be confounding the results. Even the regression-based papers failed to account for the wide range of predisposing characteristics, enabling resources, and need factors that contribute to frequent ED use.

Conclusion

Frequent ED users are a clinically fragile and sociodemographically disadvantaged population with patterns of high healthcare utilization across the board. Interventions designed to reduce frequent ED use should focus on addressing the many needs of this vulnerable population in more cost-effective settings. Further research is still warranted to understand frequent ED use in the Medicare population, frequent ED use over time, and the role of continuity of care and physician supply in mitigating the risk of frequent ED use.

Chapter 2: Methodology

The following chapter details the methodological approach I used to examine factors associated with frequent emergency department (ED) use among Medicare beneficiaries. I first describe the conceptual framework that guided my analysis. I then describe the data sources, study sample, and the construction of variables used in study analyses. Finally, I explain the statistical methods used for determining which factors are significantly associated with frequent ED use in this study.

Conceptual Model

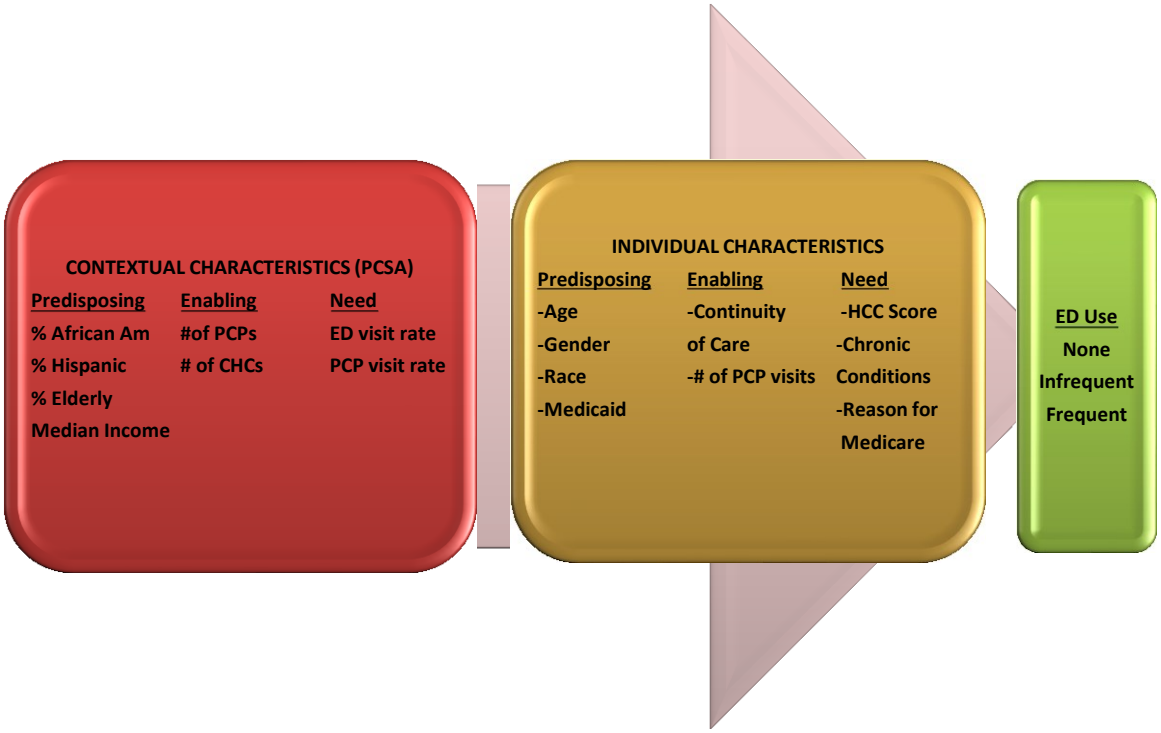
The oft-cited Andersen model of health services use, which was originally designed to measure equitable access to health care, conceptually guided this study.[11] Andersen's framework posits that utilization of health services is determined by the interaction among predisposing characteristics, enabling resources, and need. Need, both perceived and evaluated, is the immediate reason that individuals seek healthcare, and the most proximate determinant of health service utilization. Predisposing factors such as socio-demographic characteristics and health beliefs determine individual risk for developing an illness or injury (need), and enabling resources such as community services and access to primary care facilitate or inhibit the seeking of medical services to address needs. When need is the primary determinant of health service utilization, rather than predisposing characteristics or enabling resources, access to services is assumed to be equitable. Conversely, if predisposing characteristics and enabling resources explain more variance in health service utilization, it suggests inequity in access and quality. Other investigators have applied this model to explain ED utilization in general, and we do so here to describe the pathway of risk factors leading to frequent ED use.[12,13]

Andersen updated this model in 2008 to reflect the importance of contextual characteristics in addition to individual determinants of health service utilization.[37] Contextual characteristics reflect the environment, society, and other external influences on health. Contextual characteristics may also predispose (as in the demographic composition of a community), enable (as the supply of medical personnel and facilities) or influence need for health services (as in a community's propensity to use the emergency room). These factors interact with individual person-level characteristics, which predispose, enable, or influence need for health services, as discussed in the previous paragraph. Thus, the combination of contextual and individual characteristics are conceptualized as leading to health behaviors such as personal health practices (i.e. nutrition and fitness), processes of medical care (i.e. physician-patient communication, ordering certain tests or prescriptions), and use of personal health services (such as physician and emergency department visits).

This dissertation is predominantly directed toward understanding the relationship between primary care and emergency department use. The main variables of interest are measures of primary care, at two levels: (1) the supply of primary care physicians and community health centers in a beneficiary's primary care service area (PCSA), at the contextual level, and (2) beneficiary continuity of care with outpatient physicians at the individual level. Other contextual level factors such as socio-demographic composition and health indices of the community will be incorporated into the analyses as control variables. Individual level factors relating to predisposing characteristics such as race, age, and Medicaid eligibility, and need, such as chronic disease diagnoses and HCC scores, will also be used to help isolate the effect of primary care factors. By studying both contextual and individual-level factors, I can observe their relative contribution to frequent ED use and determine if frequent ED use is a function more of an individual's risk or a product of

residing in a vulnerable community. Figure 2 illustrates the concepts of interest in this study and their interrelationships.

Figure 2: Conceptual Framework, Applied to Frequent ED Use



Study Questions

This study was designed to address 3 major gaps in the available literature describing the phenomenon of frequent ED use, as further detailed in Chapter 2. First, the study sought to provide an understanding of the prevalence of frequent ED use among older adults enrolled in the Medicare program. Second, the study elucidates the association between primary care characteristics, specifically continuity of outpatient care and availability of primary care, with frequent ED use. Last, the study for the first time describes persistent frequent ED use over two years of time. To this end I conducted 2 separate analyses: 1) a cross-sectional examination of frequent ED use in 2010 among Medicare beneficiaries, with a particular attention to primary-care level variables, and 2) a longitudinal examination of frequent ED use from 2009-2010, also with an emphasis on primary care level factors.

Data Sources

This study draws on several linked data sources, including administrative claims and socio-demographic information from the Chronic Condition Data Warehouse (CCW), beneficiary-level hierarchical categorical condition (HCC) scores and a beneficiary timeline file from internal records at CMS, and market-level characteristics from the Dartmouth Atlas Project. Each data source is further discussed in the text that follows.

The CCW combines claims data across the continuum of services that are reimbursed by the Medicare program. Using a unique beneficiary identification number, information regarding inpatient, outpatient, skilled nursing facility, home health, hospice and Part D prescription drug use may be linked to demographic and assessment data for a given beneficiary.[38] Among the CCW files is a Beneficiary Summary File (BSF) that includes basic Medicare enrollment information such as month by month enrollment in Part A hospital insurance, Part B supplementary medical insurance, Medicare Advantage coverage, original reason for Medicare enrollment entitlement (aged, disabled, ESRD, or disabled with ESRD) as well as whether or not the beneficiary has a valid date of death from the National Death Index (NDI) for the reference year. The BSF has information on socio-demographic factors including age at the end of the reference year, gender, race (OMB race code, and RTI race code), and Medicaid enrollment by month. The CCW also includes administrative claims; billing files are delineated by type of service. Part A hospital claims appear in the inpatient file. Part B claims are represented in two files: a carrier file for physician visits and an outpatient file for services that are provided in locations other than a physician office or hospital, such as ED visits that do not result in a hospital admission

HCC scores are a summary measure of predicted utilization for each beneficiary based on a system developed by CMS for risk adjustment of reimbursement to managed care

plans.[39] The timeline file lists the residential setting of a beneficiary on each day of a calendar year. Every day from 1-366 contains an indicator for whether the beneficiary was in the community, inpatient hospital, skilled nursing facility, or residential nursing facility. Beneficiaries with 3or more months of nursing home stays in a calendar year are assigned an institutional flag for purposes of compiling their HCC score. Both the HCC and timeline files can be directly linked to the CCW via the same unique beneficiary identification number that unites files within the CCW.

Remaining variables used in this study were obtained from the Dartmouth Atlas Project, an ongoing effort by The Dartmouth Institute for Health Policy and Clinical Practice to document geographic variations in healthcare utilization and outcomes in the US using Medicare data. The Dartmouth Atlas Project produces free, downloadable reports of physician supply and other relevant variables at the national, regional, and local level.[40] I included measures describing socio-demographic and clinical characteristics within a particular geographic area as well as the availability of physicians and health centers in the region. The smallest unit of analysis is the Primary Care Service Areas (PCSA). A total of 6,542 PCSAs exist nationally, which are defined by aggregating ZIP code areas to reflect Medicare patient travel to primary care providers. [41] I merged Dartmouth Atlas variables with the BSF by matching zip codes in the BSF with information from the corresponding PCSA, using publically available crosswalk files. The Dartmouth Atlas is restricted to PCSA indicators for the 50 US states.

Study Design and Sample

This is a retrospective analysis of secondary administrative claims from the Medicare program for calendar years 2009-2010 that draws from a sampling frame of a random 20% sample of Medicare beneficiaries. A number of exclusion criteria were applied. First,

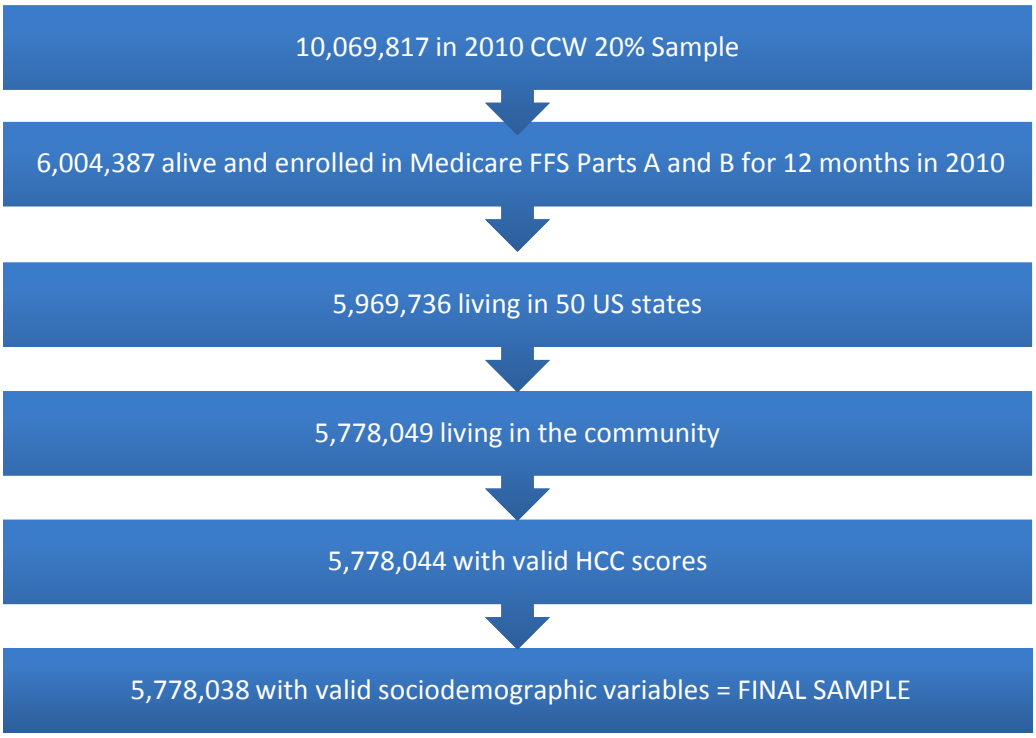
encounter data for beneficiaries in Medicare Advantage managed care plans are maintained by private health plans, thus beneficiaries enrolled in these plans were excluded from the study sample.[38] Second, in order to have complete records of inpatient and outpatient service use, I limited the analysis to those beneficiaries who were alive and covered continuously by Parts A and B fee-for-service (FFS) for the entire study period. Because of my particular interest in community-based primary care, and because nursing facilities typically contract with physicians on behalf of residents, I further restricted the analysis to beneficiaries residing the community. Finally, I eliminated beneficiaries residing outside the United States since Dartmouth Atlas restricts its reports to the 50 United States.

In summary, for the cross-sectional analysis, all beneficiaries with full-year Parts A and B fee-for-service (FFS) Medicare coverage in 2010 who survived the entire year and lived in the community, in the 50 US States, were included. Exclusion criteria were enrollment in an MA plan for any part of the year, disenrollment from Medicare Part A or B for any part of the year, nursing home placement for 3 months or longer or death in 2010, or residence outside the US. After excluding 4,291,779 beneficiaries who did not meet eligibility criteria, I was left with a sample size of 5,778,038. Figure 3 illustrates the sample construction for the cross-sectional analysis.

As demonstrated in Table 4, beneficiaries included in the analysis had a statistically significantly different age and race distribution than excluded beneficiaries; beneficiaries ages 65-74 and who were identified as Hispanic were more likely to be excluded. Beneficiaries 75-84 years of age and Caucasians were more likely to be included in the sample. The distribution of gender, original reason for Medicare entitlement, and Medicaid eligibility was similar between the 2 groups.

For the longitudinal analysis, all beneficiaries continuously enrolled in Medicare Parts A and B for the 24 month period between January 2009 and December 2010 were included.

Figure 3: Sample Construction for Cross-Sectional Analysis



All beneficiaries with one month or more of MA coverage, or one month or more of disenrollment from Medicare Parts A and B were eliminated from consideration, as were those who died during the 2-year study period or resided in a nursing home for 3 months or more in either study year. After dropping 4,633,692 beneficiaries who did not fit the specifications, I was left with a sample size of 5,186,523. Figure 4 illustrates the sample construction for the longitudinal analysis.

As presented in Table 5, beneficiaries included in the longitudinal analysis were statistically significantly more likely to be in the younger age groups, with the exception of 55-64 year olds. There was also greater representation of 75-84 year-olds, females, whites, and people who qualified for Medicare based on disability in the sample. The oldest-old and

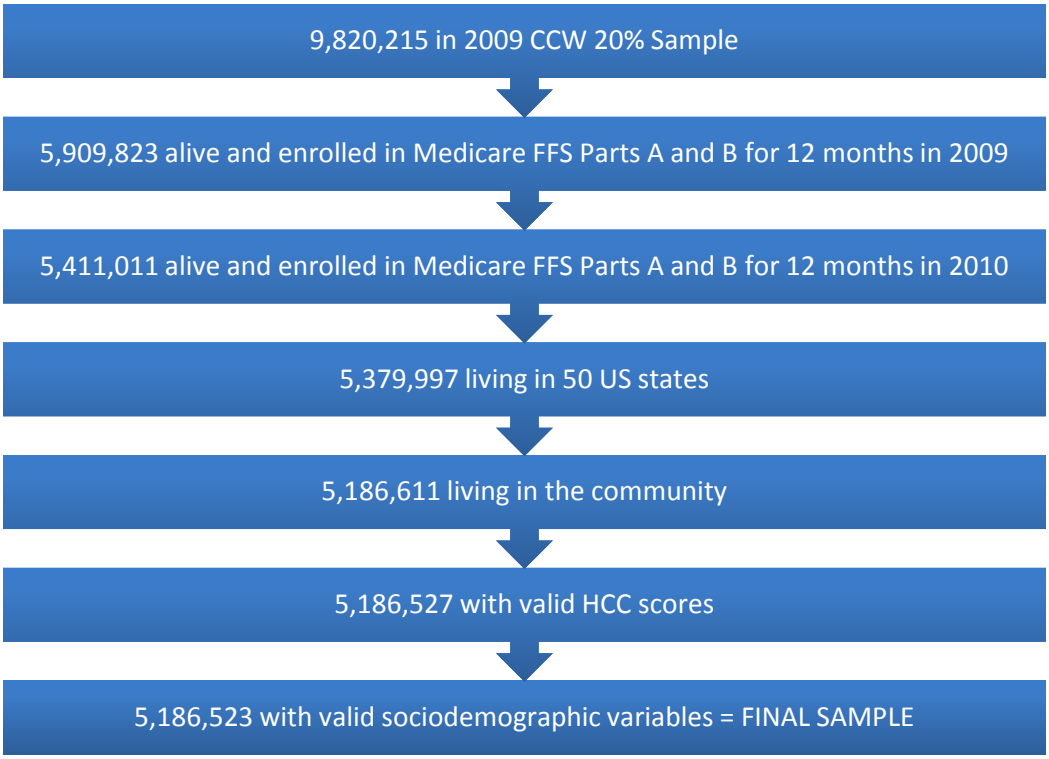
Hispanics were more prevalent in the excluded population. The prevalence of beneficiaries enrolled in Medicaid was similar in the 2 groups.

Table 4: Characteristics of Beneficiaries Included in vs. Excluded from Sample: 2010 Cross-Sectional Analysis*					
	Sample		Excluded		Missing
	5,778,038		4,291,779		
	N	Percent	N	Percent	
Age Category					
18-34	99,665	1.72	50,798	1.18	
35-44	155,795	2.70	82,005	1.91	
45-54	319,518	5.53	192,933	4.50	
55-64	449,182	7.77	331,888	7.73	
65-74	2,384,910	41.28	2,037,559	47.48	
75-84	1,662,087	28.77	1,024,853	23.88	
85+	706,881	12.23	571,743	13.32	
Gender					22
Male	2,567,844	44.44	1,944,337	45.30	
Female	3,210,194	55.56	2,347,420	54.70	
Race					
Caucasian	4,697,549	81.30	3,062,612	71.36	
African-American	549,027	9.50	454,456	10.59	
Asian/Pacific Islander	126,498	2.19	133,719	3.12	
Hispanic	319,546	5.53	500,714	11.67	
Native American	28,825	0.50	14,122	0.33	
Other/Unknown	56,593	0.98	126,156	2.94	
Original Reason for Medicare Entitlement					1
Old Age	4,333,741	75.00	3,321,521	77.39	
Disability	1,403,635	24.29	946,510	22.05	
ESRD	14,844	0.26	14,242	0.33	
Disability and ESRD	25,818	0.45	9,505	0.22	
Medicaid Eligibility					
0 Months	4,622,002	79.99	3,454,838	80.50	
1-12 Months	1,156,036	20.01	836,941	19.50	
*All Results Statistically Significant at .05 level					

Independent Variables

Table 6 summarizes the independent variables used in this study, their source, and the year for which the variable was measured.

Figure 4: Sample Construction for Longitudinal Analysis



Socio-demographic (Predisposing) Characteristics:

At the individual level, we examined beneficiary age, gender, race, and Medicaid eligibility. Age (2010 for the cross sectional analysis, 2009 for the longitudinal analysis) was analyzed as a categorical measure using the following cut points: 18-34, 10 year blocks from ages 35 to 84, and 85 and older. For race, the Research Triangle Institute (RTI) race code was used because prior research has demonstrated that it captures more beneficiaries of Hispanic ethnicity due to its more inclusive criteria for finding Spanish surnames.[42] The Beneficiary Summary File includes a variable indicating the number of months in a calendar year that a member was enrolled in Medicaid. Any beneficiary with at least one month of Medicaid enrollment during 2010 (cross-sectional analysis) or 2009-2010 (longitudinal analysis) was categorized as "Medicaid eligible" in this study. At the contextual level, I

Table 5: Characteristics of Beneficiaries Included in vs. Excluded from Sample: 2009-2010 Longitudinal Analysis*					
	Sample		Excluded		Missing
	n=5,186,523		n=4,633,692		
	N	Percent	N	Percent	
Age Category					
18-34	89,169	1.72	53,246	1.15	
35-44	145,366	2.80	91,407	1.97	
45-54	289,231	5.58	212,551	4.59	
55-64	386,410	7.45	353,160	7.62	
65-74	2,175,525	41.95	2,109,347	45.52	
75-84	1,526,687	29.44	1,145,470	24.72	
85+	574,135	11.07	668,511	14.43	
Gender					*22*
Male	2,292,621	44.20	2,096,804	45.25	
Female	2,893,902	55.80	2,536,866	54.75	
Race					
Caucasian	4,249,030	81.92	3,354,775	72.40	
African-American	474,396	9.15	494,281	10.67	
Asian/Pacific Islander	110,805	2.14	135,327	2.92	
Hispanic	278,515	5.37	503,233	10.86	
Native American	25,625	0.49	15,798	0.34	
Other/Unknown	48,152	0.93	130,278	2.81	
Original Reason for Medicare Entitlement					
Old Age	3,918,046	75.54	3,580,091	77.26	
Disability	1,234,702	23.81	1,024,851	22.12	
ESRD	11,952	0.23	16,459	0.36	
Disability and ESRD	21,823	0.42	12,291	0.27	
Medicaid Eligibility in 2009					
0 Months	4,186,289	80.71	3,722,632	80.34	
1-12 Months	1,000,234	19.29	911,060	19.66	
*All Results Statistically Significant at .05 level					

controlled for the proportion of the population residing in each PCSA categorized by race/ethnicity (Black and Hispanic) and age (over 65 years of age) as well as the median household income in the PCSA. Since these variables are associated with frequent ED use at the individual level, I reasoned that they could also have an effect at the geographic level.

Outpatient Care (Enabling Resources)

I constructed individual-level measures of continuity of outpatient care using the Continuity of Care Index (COCI), a measure of dispersion of outpatient evaluation and management (E&M) visits in a calendar year. COCI is a function of how many E&M appointments a patient has across unique doctors.[29] It reflects fragmentation of outpatient care among primary and specialty care providers. The formula is as follows:

$$\text{COCI} = \square \sum_{i=1} n_j^2 - N / N(N-1)$$

Where
N= The total number of physician visits in which E&M codes were generated
nj=number of visits to ith different provider, i=1,2,….,M
M= number of potentially available providers

Table 7 illustrates how hypothetical patient physician utilization during a calendar year would be represented by the COCI. A low value, such as that of Patient 3, would thus reflect high numbers of visits to different providers, whereas the highest value of 1 occurs when all visits are to the same provider, as is the case with Patient 1. In a systematic review of articles using the COCI, Jee and Cabana established that the COCI measure is only stable and informative among patients with several physician visits.[29] A recent study in a Medicare Advantage population used a cutoff of 3 or more E&M visits to calculate COCI.[43] In this study, I examined the COCI as both a continuous and categorical variable. For the latter, I split the sample into tertiles based on the distribution of scores and classified beneficiaries as having low, medium, or high continuity, as done in previous research.[31,32,44]

Table 6: Variables, Source, and Year			
Variable	**Description**	**Source**	**Year**
Sociodemographic Variables			
Individual Level			
Age	Beneficiary Age at End of Reference Year	CCW	2010; 2009
Gender	Beneficiary Sex	CCW	2010; 2009
Race	Research Triangle Institute Race Code	CCW	2010; 2009
Medicaid Status	Month Count of Beneficiary State Buy-In Coverage (≥1)	CCW	2010; 2009
Contextual Level			
Percent Black	Number of Black or African American alone in PCSA/2008 estimated population in PCSA	Atlas	2008
Percent Hispanic	Number of Hispanics in PCSA/2008 estimated population in PCSA	Atlas	2008
Percent Elderly	Number of people aged 65+ in PCSA/2008 estimated population in PCSA	Atlas	2008
Median Household Income	Median household income in PCSA	Atlas	2008
Primary Care/Health System Variables (Enabling Resources)			
Individual Level			
Continuity of Care	See Formula in Methods	CCW	2010; 2009 and 2010
Number of Primary Care Visits	Count of unique physician visits in study period	CCW	2010; 2009 and 2010
Specialty of Primary Care Physician	Specialty Code of Plurality Provider	CCW	2010
Contextual Level			
Number of primary care physicians/1,000 in PCSA	Number of clinically active, non-Federal, Primary Care physicians in PCSA/2007 Estimated Population in PCSA	Atlas	2007
Number of community health centers in PCSA	Number of Federally Qualified Health Centers + Number of Rural Health Centers/2007 Estimated Population in PCSA	Atlas	2007
Clinical Variables (Need)			
Individual Level			
HCC score	HCC score	CMS - Internal	2010; 2009

Variable	Description	Source	Year
Clinical Variables (Need)			
Individual Level (Cont.)			
Chronic disease diagnoses	Clinical Classification Software	CCW	2010; 2009 or 2010
Original Reason for Medicare Entitlement	Original Reason for Medicare Entitlement	CCW	2010; 2009
Institutional Status	Day count of nursing home placement (≥90)	CMS - Timeline	2010; 2009 and 2010
Contextual Level			
ED visit rate/1,000	Percentage of beneficiaries in PCSA with at least one ED visit	Atlas	2005
PCP visit rate/1,000	Percentage of beneficiaries in PCSA with at least one PCP visit	Atlas	2005
Dependent Variables			
ED visits	Count of ED claims (See specifications in methods)	CCW	2010; 2009-2010
Frequent Users	4+ visits in 2009, or 2010	CCW	2010; 2009-2010
Persistent Frequent Users	4+ visits in 2009 and 2010	CCW	2009-2010

Table 7: Examples of Continuity of Care Index (COCI)

	Visit 1	Visit 2	Visit 3	Visit 4	CoC Index
Patient 1	Provider A	Provider A	Provider A	Provider A	1 (perfect continuity
Patient 2	Provider A	Provider A	Provider B	Provider B	0.33
Patient 3	Provider A	Provider B	Provider C	Provider A	0.17

Exploratory data analyses were conducted to examine characteristics of beneficiaries with 3 or more visits in the study period compared to those with <3 physician visits, as previously set forth as insufficient utilization for the calculation of the COCI. These results for the cross-sectional sample are displayed in Table 8. The majority of the sample, 68.38%, incurred 3 or more physician visits in 2010. There were greater percentages of older, female, and white beneficiaries among those with 3+ E&M codes. A larger portion of the group with 3+ physician visits had qualified for Medicare based on age and were infrequent or frequent ED users in 2010, whereas a smaller portion were eligible for Medicaid compared to those with fewer than 3 visits. The mean HCC score was higher for beneficiaries with 3 + physician visits.

In order to retain those without a COCI score in my sample, I constructed a 4th category of COCI for those with fewer than 3 E&M visits in 2010 for the cross sectional analysis. COCI was calculated for each year (2009 and 2010) for the longitudinal analysis, then split into tertiles with a 4th category for those with fewer than 3 visits in the respective year. Because beneficiaries who incurred fewer physician office visits for evaluation and management appear to be healthier overall, I believe it is still relevant to examine their use of the ED in contrast to those with 3 or more E&M visits in the reference period.

Other individual-level measures of primary care included total number of physician visits with an E&M code (based on the total used in calculating the COCI) in 2010 for the cross-sectional study and in both 2009 and 2010 for the longitudinal study. Primary care availability was also examined as a contextual factor. I used Dartmouth Atlas documentation of the number of primary care physicians, Federally Qualified Health Centers (FQHCs) and CMS-certified Rural Health Centers in each participant's PCSA, which is derived from data from the American Medical Association (AMA), HRSA and CMS.[45] I then accounted for

Table 8: Characteristics of Beneficiaries With vs. Without Continuity of Care Index: 2010 Cross-Sectional Analysis*				
	3+ E&M Visits		<3 E&M Visits	
	N	Percent	N	Percent
Total Sample = 5,778,038	**3,951,054**	**68.38**	**1,826,984**	**31.62**
Age Category				
18-34	42,728	1.08	56,937	3.12
35-44	83,652	2.12	72,143	3.95
45-54	189,503	4.80	130,015	7.12
55-64	279,921	7.08	169,261	9.26
65-74	1,574,857	39.86	810,053	44.34
75-84	1,259,901	31.89	402,186	22.01
85+	520,492	13.17	186,389	10.20
Gender				
Male	1,646,990	41.68	920,854	50.40
Female	2,304,064	58.32	906,130	49.60
Race				
Caucasian	3,280,900	83.04	1,416,649	77.54
African-American	335,070	8.48	213,957	11.71
Asian/Pacific Islander	85,055	2.15	41,443	2.27
Hispanic	197,306	4.99	122,240	6.69
Native American	17,948	0.45	10,877	0.60
Other/Unknown	34,775	0.88	21,818	1.19
Reason for Medicare Enrollment				
Old Age	3,051,895	77.24	1,281,846	70.16
Disability	869,792	22.01	533,843	29.22
ESRD	10,357	0.26	4,487	0.25
Disability and ESRD	19,010	0.48	6,808	0.37
Medicaid Eligibility in 2010				
0 Months	3,193,963	80.84	1,428,039	78.16
1-12 Months	757,091	19.16	398,945	21.84
HCC Score (Mean, SD)	1.18	0.97	0.73	0.65
ED Visit Category				
Non User	2,590,167	65.56	1,508,283	82.56
Infrequent User	1,199,293	30.35	289,700	15.86
Frequent User	161,594	4.09	29,001	1.59
*All Results Statistically Significant at .05 level				

the population residing in each PCSA for a better representation of each beneficiary's access to primary care services. This measure was derived by determining the number of PCPs and CHCs, dividing by the population in each PCSA, and multiplying by 1000.

Clinical (Need) Characteristics

Specific chronic conditions that met at least two of the following criteria: (1) major cause of ED visits in the Medicare population, (2) prevalent in the Medicare population, and (3) costly to the Medicare program were examined in this study. To identify conditions that were major causes of ED visits (the first criterion), I examined the top 25 all-reported diagnoses listed on claims for ED visits by Medicare patients in the Nationwide Emergency Department Sample (NEDS). NEDS is a database provided through the Healthcare Cost and Utilization Project (HCUP), an initiative sponsored by the Agency for Healthcare Research and Quality (AHRQ) that combines healthcare utilization data from federal, state, local, and private sources.[46] All reasons for ED visits are classified using the CCS. The 10 most common chronic conditions reported in the top 25 ED visits among Medicare beneficiaries in 2010 were: hypertension, hyperlipidemia, diabetes, congestive heart failure, other heart disease, COPD, substance abuse, chronic renal failure, mood disorders, and dementia/delirium.

In terms of the most prevalent chronic conditions, (the second criterion), The Centers for Medicare and Medicaid Services tracks treated prevalence of chronic diseases annually from ICD-9 diagnosis and procedure codes listed in administrative claims data using the 100% CCW file. In 2010, the top 10 most common chronic conditions among Medicare FFS beneficiaries were hypertension (58%), hyperlipidemia (45%), ischemic heart disease (31%), arthritis (29%), diabetes (28%), heart failure (16%), chronic kidney disease (15%), depression (14%), COPD (12%) and Alzheimer's disease (11%).[47]

As for chronic conditions that are most costly (the third criterion), Thorpe, Ogden and Galactionova used data from the Medical Expenditure Panel Survey (MEPS) to determine the 10 most costly conditions in Medicare beneficiaries, arranged by multi-level CCS codes.[48] They found that the highest expenditures and largest contribution to spending growth were attributable to hyperlipidemia, kidney disease, COPD/asthma, diabetes mellitus, hypertension, osteoarthritis, mental disorders, cancer, trauma-related disorders, and heart conditions. Table 9 lists the diseases that met at least 2 criteria and were thus included in the analysis.

Table 9: List of Chronic Conditions and CCS Codes

CCS Single-Level Codes	CCS Multi-Level Code	Top 10 ED Diagnoses	Top 10: Prevalence	Top 10: Cost
108		Congestive Heart Failure (CHF)	Congestive Heart Failure (CHF)	Congestive Heart Failure (CHF)
127		Chronic Obstructive Pulmonary Disease (COPD)	Chronic Obstructive Pulmonary Disease (COPD)	Chronic Obstructive Pulmonary Disease (COPD)
98, 99	7.1	Hypertension	Hypertension	Hypertension
53		Hyperlipidemia	Hyperlipidemia	Hyperlipidemia
49, 50		Diabetes mellitus	Diabetes mellitus	Diabetes mellitus
96, 97, 100-107	7.2	Diseases of the Heart (excluding CHF)	Diseases of the Heart (excluding CHF)	Diseases of the Heart (excluding CHF)
650-652, 654-663, 670	5	Mental illness (excluding dementia)	Mental illness (excluding dementia)	Mental illness (excluding dementia)
156-158, 160, 161		Kidney Disease	Kidney Disease	Kidney Disease
653		Dementia	Dementia	Dementia
201-204			Arthritis	Arthritis

Chronic diseases were identified from diagnoses listed in administrative claims. Diagnoses associated with each chronic disease were identified on the basis of the Clinical Classification Software (CCS). The CCS was developed by the Agency for Healthcare Research and Quality (AHRQ) for the Healthcare Cost and Utilization Project (HCUP). In the CCS, more than 14,000 ICD-9-CM diagnosis codes and 3,900 procedure codes are

aggregated into a smaller number of clinically meaningful categories that are easier to analyze and interpret.[49] The CCS now includes categories from the Clinical Classifications Software for Mental Health and Substance Abuse (CCS-MHSA). I applied CCS codes to all ICD-9 codes listed on all beneficiary inpatient and outpatient claims in 2009 and 2010. If a beneficiary had 2 or more outpatient claims or 1 or more inpatient claims in a calendar year for the previously defined disease or condition of interest longitudinal analysis, they were counted as having that illness, consistent with criteria used in previous studies.[50] Chronic disease diagnoses were flagged for 2010 in the cross-sectional analysis and in 2009 and 2010 for the longitudinal analysis. For the latter study, beneficiaries were considered to have the condition if they met the inclusion criteria in 2009 or 2010.

The other clinical variables used in the analysis included the HCC score in 2010 for the cross-sectional analysis and in 2009 in the longitudinal analysis. I also assessed original reason for Medicare entitlement, which included old age, disability, ESRD, or disability and ESRD. At the contextual level, I included as a measure the proportion of the population residing in each PCSA who incurred at least one ED visit and one physician visit in 2005, the most recent year available in the Dartmouth Atlas. Since these variables are associated with frequent ED use at the individual level, I hypothesized that they could also have an effect within a geographic region.

Dependent Variables

ED visits: ED visits were identified from two files of administrative claims included in the CCW. Medicare beneficiaries seen in the emergency room and admitted to the hospital are represented in the inpatient file, whereas those seen in the ED but released are represented in the outpatient file.[51] Both types of ED claims can be identified by Revenue Center Codes 0450-0459 and 0981. Revenue center codes indicate the final claims paid by

CMS, and are more reliable than "source of admission" codes, which are recorded by various clinical staff and not used for reimbursement purposes.[42] ED visits that result in observation stays typically have an associated ED claim if the beneficiary is not ultimately admitted to the hospital, since payment is guaranteed for the ED visit but not necessarily the extended observation stay. I eliminated duplicate claims for each beneficiary and date combination and then developed a count variable for each beneficiary representing the number of ED visits in 2010 for the cross-sectional analysis and each year from 2009 to 2010 for the longitudinal analysis.

Frequent ED Use: I assigned beneficiaries to categories of frequent ED use based on the number of ED visits incurred during 2010 (cross-sectional analysis) or in 2009 and 2010 (longitudinal analysis). Frequent ED use refers to 4 or more visits in a calendar year, based on its validation in previous literature (see Chapter 2). In the cross-sectional analysis, beneficiaries with no ED visits in 2010 were considered non-ED users while those with 1-3 visits were classified as infrequent ED users. In the longitudinal study, beneficiaries were assigned to categories for 2009 and 2010 using the same cutoff points as in the cross-sectional analysis. Frequent ED users were further categorized by the persistence of frequent ED use over the 2-year study period for the descriptive analysis. Prior research has suggested that these "chronic" frequent ED users may be clinically different and more amenable to intervention than frequent ED users in one year who return to non-use or infrequent use in the subsequent year (see Chapter 2). Beneficiaries with 4 or more visits in both 2009 and 2010 were therefore considered "persistent" frequent ED users. Beneficiaries with one year of frequent ED use in 2009 or 2010 were considered "episodic" frequent ED users. Those with no ED visits during the study period were labeled as non-ED users, while those with 1-3 visits in at least one of the study years were classified as infrequent ED users.

The prevalence of beneficiaries in each ED user group is displayed in Table 10 for the cross-sectional and Tables 11 and 12 for the longitudinal analysis. In each reference year, approximately 70% of Medicare beneficiaries were non-ED users, while 25% were infrequent ED users and 3% were frequent ED users. Most frequent ED users in 2009 regressed to non-ED use or infrequent ED use in 2010, with just over 1/3 remaining frequent ED users. Only 1.16% of beneficiaries in the sample were persistent frequent ED users, who incurred 4 or more ED visits in both 2009 and 2010.

Table 10: 2010 Frequent ED Use		
	N	**Percent**
Non-Users	4,181,264	70.07
Infrequent Users (1-3 visits)	1,571,546	26.34
Frequent Users (4+ visits)	214,040	3.59
TOTAL	5,966,850	100.00

Table 11: Frequent ED Use across 2009 and 2010		
2009		
	N	**Percent**
Non-Users	3,767,693	72.64
Infrequent Users	1,256,299	24.22
Frequent Users	162,531	3.13
2010		
	N	**Percent**
Non-Users	3,664,290	70.65
Infrequent Users	1,339,943	25.84
Frequent Users	182,290	3.51
2009-2010		
	N	**Percent**
Non-Users	2,954,995	56.97
Infrequent Users	1,946,927	37.54
Occasional Frequent Users	224,381	4.33
Persistent Frequent Users	60,220	1.16
TOTAL	5,186,523	100.00

Table 12: 2009 and 2010 ED User Categories						
	2010 ED User Category					
	Non-Users		Infrequent Users (1-3 visits)		Frequent Users (4+ visits)	
2009 ED User Category	N	Percent	N	Percent	N	Percent
Non-Users	2,954,995	78.43	768,410	20.39	44,288	1.18
Infrequent Users (1-3 visits)	675,327	53.76	503,190	40.05	77,782	6.19
Frequent Users (4+ visits)	33,968	20.90	68,343	42.05	60,220	37.05

Missing Data

Missing data in the CCW and Medicare internal files is minimal and no more than 300 beneficiaries lacked any of the socio-demographic, primary care, or clinical variables derived from these data sources. Because I retained beneficiaries with an insufficient amount of E&M visits to calculate the COCI, I was able to avoid the potential bias from excluding them from my analysis. However 3 potential concerns of non-random missing data remain related to the sample construction.

First, because claims from Medicare Advantage enrollees are not housed at CMS, beneficiaries enrolled in managed care were necessarily excluded. These beneficiaries, who comprise 28% of the Medicare population[52], may be systematically different than beneficiaries in traditional FFS Medicare in terms of sociodemographic characteristics, regional market forces that influence the penetration of MA plans, and access to and quality of healthcare services. More germane to this study, MA beneficiaries may be deterred from frequently using the ED due to the inherent restrictions and cost-sharing structure of managed care plans or because they receive better preventive care.[53]

Furthermore, beneficiaries living in US territories were excluded from the analysis as information regarding contextual PCSA-level factors were not available. This resulted in a disproportionate amount of Hispanics and Asian/Pacific Islanders being eliminated from the analysis. Finally, eliminating beneficiaries that died during the study period introduced a

potential bias. Beneficiaries may incur several ED visits at the end of life, and while this issue was not a specific focus of this study it warrants further investigation. Additionally, the beneficiaries that survived the entire study period may be healthier than the average Medicare population that includes decedents.

Statistical Analysis

I first examined the distribution of Medicare beneficiaries within the 3 categories of non-, infrequent, and frequent ED use in 2010, and the 4 categories of non-, infrequent, episodic frequent and persistent frequent ED use in 2009-2010. I made comparisons among the different types of ED users using chi-squared statistics for categorical variables and ANOVA for continuous variables. Next, bivariate and multivariate multinomial logistic regressions were used to determine the relative risk ratio of being a frequent or infrequent ED user compared a non- ED user in 2010. For the cross-sectional analysis, we created a model of frequent ED use in 2010 based on socio-demographic, primary care, and clinical variables. For the longitudinal analysis, we created a model to predict ED use in 2010 based on the same independent variables as well as frequent ED use in the previous year.

The multinomial logistic regression model is an extension of the simple logistic regression model for dichotomous dependent variables that applies to discrete, nominal, and unordered poltytomous dependent variables.[54] Unlike ordinal logistic regression models, multinomial models do not assume proportional odds for being in each category higher than the base category and instead estimate separate equations for each category compared to the base category.[55] The formula would be as follows:

$$\ln\left(\frac{\Pr(ED=frequent)}{\Pr(ED=none)}\right)=\beta_0+\beta_i X_1$$

$$\ln\left(\frac{\Pr(ED=frequent)}{\Pr(ED=infrequent)}\right)=\beta_0+\beta_i X_1$$

Where:

1) β_0 is the constant for each category
2) β_i is a vector of coefficients for each category
3) X_1 is a vector of covariates for each category

As in the case of the simple logistic regression, maximum likelihood estimation (MLE) is used as the normality assumption of ordinary least squared (OLS) regression is violated.[54]

Transition models describe the conditional distribution of the dependent variable as an explicit function of its previous values and a set of covariates.[56] In this case, we calculated the relative risk ratio of frequent ED use in 2010 as a function of frequent ED use in 2009 and socio-demographic, primary care, and clinical factors as previously described. We also estimated the marginal probability of frequent ED use in 2010 given different combinations of the independent variables, including frequent use in 2009.

For ease in interpreting relative risk ratios, we standardized all continuous variables. Wald tests were used to test the significance of regression coefficients. We used robust estimates of standard errors to account for beneficiary clustering at the PCSA level. This "sandwich estimator" controls for within-cluster correlation when the independence assumption of traditional linear models is violated.[57] We first ran models containing only the primary care level variables, then added socio-demographic and clinical variables in succession and compared the Akaike Information Criterion scores of full versus parsimonious models. Data management and descriptive statistics were conducted using SAS Enterprise Guide 5.1 software; bivariate and multivariate multinomial logistic regression and Markov analyses were conducted in STATA 12.[58,59]

Sensitivity Analysis

To test the assumptions of the multinomial model, I conducted 2 sensitivity analyses. To confirm that ED categories were more not more appropriately represented in an ordinal model with proportional odds, I conducted a likelihood ratio test of the full model using an ordinal structure and compared to the full model using a multinomial structure. The p-value of 0.55 indicated that I was sufficiently able to reject the null hypothesis that the ordinal model was superior. I also tested the Independence of Irrelevant Alternatives (IIA) assumption by conducting a Hausmann test. I created subsamples of frequent ED users and non-ED users exclusively as well as infrequent and non-ED users exclusively and performed logistic regressions. The odds ratios were virtually identical to the relative risk ratios found in the multinomial model with all three types of ED users.

Human subjects considerations

This study was approved by the Internal Review Board at the Johns Hopkins Bloomberg School of Public Health. Beneficiary-level data was de-identified except for zip code and date of birth, which were not linked to individual beneficiaries at any point. All data was accessed via a secure virtual desktop.

Chapter 3: Manuscript 2

Frequent Emergency Department Use in the Medicare Population: The Role of Continuity of Care

Erin Murphy Colligan

ABSTRACT

Context: Frequent emergency department (ED) use in the Medicare population is an important issue that is not well understood, particularly with respect to the primary care level factors influencing frequent ED use.

Objective: This research examined frequent ED use among Medicare beneficiaries in 2010.

Study Design: We conducted a retrospective, claims-based analysis of FFS Medicare beneficiaries using a 20% sample from the Chronic Condition Warehouse and other linked sources. Frequent ED use, defined as 4 or more visits in a calendar year, was studied using the Andersen framework to guide the analysis. Sociodemographic variables such as age and race were considered as predisposing characteristics, primary care variables such as the number of and continuity of care across outpatient physician visits were included as enabling resources, and clinical variables such as chronic disease diagnoses were used to describe need. We performed multinomial logistic regression to determine the relative risk ratio of frequent ED use versus non-ED use and frequent ED user versus infrequent ED use in 2010.

Principle Findings: Frequent ED users comprised less than 4% of the FFS Medicare population. Frequent ED users were more likely than non-users and infrequent users to be younger, African-American, Medicaid eligible, female, and in poor physical and mental health. They also frequently visited physician offices. The youngest group of disabled beneficiaries, those aged 18-34, had nearly 11 times the risk of frequent of frequent ED use (RRR 10.50, CI 10.21-10.77), the strongest effect observed in this analysis. Low continuity

of care was associated with 26% greater relative risk of frequent compared to non-ED use. Clinical factors were the most strongly associated with frequent ED use, particularly heart disease (RRR 5.21, CI 5.12-5.30), congestive heart failure (RRR 3.01, CI 2.95-3.07), dementia (RRR 5.82, CI 5.82-5.68), mental illness (RRR 5.96, CI 5.86-6.07) and chronic kidney disease (RRR 3.32, CI 3.27-3.37).

Conclusion and Policy Implication: While age and clinical risk factors are the most highly associated with frequent ED use, the effect of continuity of care suggests that improving coordination among Medicare providers can reduce frequent ED use.

Introduction

Frequent emergency department (ED) use is a topic of practical and policy significance with quality, cost, and human implications. Despite representing only 8% of ED patients, people who use the ED 4 or more times in one-year (frequent ED users) account for 28% of all ED visits in the US.[3,4] Frequent ED users are more likely than infrequent ED users to arrive by ambulance and to be admitted to the hospital; once in the hospital, they stay for longer periods of time.[3,5,6] Frequent ED users are also a resource-intensive population that relies heavily on a range of services such as physician and hospital care.[3,4,7]

The topic of frequent ED use is of particular concern to the Medicare program. Medicare beneficiaries are nearly twice as likely as privately insured individuals to be frequent ED users.[4] ED visits are particularly hazardous events for older adults, as they may precipitate a cascade of adverse events such as hospitalization, readmission, nursing home placement, or death.[8] Identifying potentially mutable individual and health system factors associated with frequent ED users in the Medicare population may contribute knowledge on

how to improve healthcare quality and reduce avoidable costs. This article seeks to identify predictors of frequent ED use, with a particular orientation toward identifying risk factors at the primary care level.

Background

While frequent ED use among Medicare beneficiaries specifically is not well understood, findings from related research on other populations provide insight that may be relevant to the Medicare population. Recognizing that the evidence base is limited by varying definitions, and that the majority of studies have been conducted in a single setting with restricted generalizability, factors that span socio-demographic issues, challenges to access and quality at the healthcare system level, and clinical risk have been consistently identified as predictors of frequent ED use. These three levels of determinants coincide with predisposing, enabling, and need variables in the Anderson model of health utilization.[11] Minority race, high educational attainment, low income, public insurance, a usual source of care, high utilization of outpatient healthcare resources, and poor physical and mental health are all associated with greater odds of frequent ED use (See Chapter 2).

Despite the extensive research on frequent ED use, no studies to date have focused on the Medicare population. The role of primary care in preventing frequent ED use is also underexplored. In two recently published literature reviews, experts call for more research on frequent ED use in older adults and note "the degree to which suboptimal primary care management leads to frequent ED use has not been well explored."[3,24] This article contributes to the literature on frequent ED use by exploring the importance of primary care at the community and individual level in regard to frequent ED use in the Medicare population. The goal of this article is to provide health services researchers and policy-makers with a better understanding of potentially modifiable factors that affect frequent ED

use in order to guide future studies and inform the development of targeted interventions and policies.

Methodology

Study Design and Sample

This study was a retrospective analysis of secondary administrative claims from the Medicare program for calendar year 2010. A random 20% sample of Medicare beneficiaries was examined. All beneficiaries continuously enrolled in Medicare Parts A and B for the entire year were included. Beneficiaries with one month or more of Medicare Advantage (MA) coverage, or one month or more of disenrollment from Medicare Parts A and B were eliminated from consideration, as were those who died during the 1-year study period, were institutionalized for 3 months or greater, or lived in geographical regions either outside the 50 US states. After excluding beneficiaries who did not meet eligibility criteria (n=4,291,779), we were left with a sample size of 5,778,038. As illustrated in Table 4 (See Chapter 2, Page 28), beneficiaries included in the analysis had a different age and race distribution than excluded beneficiaries; beneficiaries ages 65-74 and who were identified as Hispanic were more likely to be excluded while 75-84 year olds were more likely to be included in the sample. The distribution of gender, original reason for Medicare entitlement, and Medicaid eligibility was similar between the 2 groups.

Data Sources

This study draws on several linked data sources, including administrative claims and socio-demographic information from the Chronic Condition Data Warehouse (CCW), beneficiary-level hierarchical categorical condition (HCC) scores and timeline files from internal CMS databases, and market-level characteristics from the Dartmouth Atlas Project. The CCW contains Part A, B and D claims as well as demographic and assessment data

linked at the beneficiary level for all Medicare fee-for-service (FFS) enrollees.[38] HCC scores are a measure of predicted utilization used to risk adjust reimbursement to managed care plans.[39] The timeline file lists the residence of a beneficiary on each day of a calendar year for community and facility-specific settings. Beneficiaries with 3 more months of nursing home stays are assigned an institutional flag for purposes of compiling their HCC score. The Dartmouth Atlas Project provides data on the socio-demographic and clinical characteristics of a population as well the availability of physicians and health centers in a particular geographic region.[40] The smallest unit of analysis is the Primary Care Service Areas (PCSA). There are 6,542 PCSAs nationally, which are defined by aggregating ZIP areas to reflect Medicare patient travel to primary care providers.[41] We merged Dartmouth Atlas variables with the CCW by matching beneficiary zip codes with information from the corresponding PCSA, using publically available crosswalk files.

Independent Variables

Sociodemographic (Predisposing) Characteristics: We examined beneficiary age at the end of the reference year, gender, race, original reason for Medicare enrollment, and Medicaid eligibility at the individual level. Age was collapsed into categories of 18-34 and by 10-year increments from ages 35 to 85 and older. For race, the Research Triangle Institute (RTI) race code was used because prior research has demonstrated that it captures more beneficiaries of Hispanic ethnicity due it its more inclusive criteria for finding Spanish surnames.[42] Individual income is not available in the CCW. Any beneficiary with at least one month of Medicaid enrollment during 2010 was considered to be Medicaid eligible in these analyses. At the contextual level, percent African-American, percent Hispanic, percent elderly, and median income at the PCSA level were used to control for geographic effects that may influence frequent ED use.

Primary Care (Enabling Resources): We constructed individual-level outpatient care measures of continuity of care using the Continuity of Care Index (COCI), a measure of dispersion of outpatient evaluation and management (E&M) visits in a calendar year. COCI is a function of how many outpatient E&M appointments a patient has across unique doctors.[29] A recently published study suggests the CoC index is only valid among individuals with 3 or more E&M visits in the prior year.[43] Therefore, we examined characteristics of beneficiaries with 3 or more versus 0-2 E&M visits in the observation year. These results are displayed in Table 8 (See Chapter 2, Page 35). Those with 3+ E&M visits were older and more likely to be female, Caucasian, and to have qualified for Medicare based on old age. As expected by their greater number of E&M visits, beneficiaries included in the COCI analysis also had higher mean HCC scores. The CoC Index was calculated then converted into a categorical variable using tertiles for ease of interpretation, as in previous research.[31],[32],[33] In this sample the tertiles were less than or equal to 0.18, 0.19-0.35, and greater than 0.36. In order to retain those without a COCI score, we categorized beneficiaries with fewer than 3 E&M visits into a 4th group.

Other individual-level primary care characteristics studied were total number of physician visits during which the beneficiary was evaluated in 2010 (from the total used in calculating the COCI), and whether the beneficiary's usual provider was a generalist or specialist. The usual provider was defined as the person who filed a plurality of E&M claims in a calendar year. Pham and colleagues used the "plurality provider algorithm", which considers the provider that charged for the largest number of E&M visits as the usual provider, and found that it resulted in more beneficiaries being "assigned" than other methods.[60] Provider specialty was determined on the basis of provider type codes listed in claims, which were linked to the CMS taxonomy for medical suppliers and providers.[61]

Beneficiaries were labeled according to whether or not the usual provider's specialty fit into one of the "generalist" categories of general practice, family practice, internal medicine, or pediatric medicine, versus all other provider "specialists".

Primary care was also examined as a contextual factor. Using the Dartmouth Atlas, we examined the number of primary care physicians (PCPs), and community health centers (CHCs), including Federally Qualified Health Centers (FQHCs) and CMS-certified Rural Health Centers, in each participant's PCSA. We then divided the number of PCPs and CHCs in the PCSA by the population of the PCSA and multiplied by 1,000 in order to assess each beneficiary's access to primary care services.

Clinical (Need) Characteristics: Chronic disease diagnoses were assigned using the Clinical Classification Software (CCS), which was developed by the Agency for Healthcare Research and Quality (AHRQ) for the Healthcare Cost and Utilization Project (HCUP). In the CCS, more than 14,000 ICD-9-CM diagnosis codes and 3,900 procedure codes are aggregated into mutually exclusive clinically meaningful categories.[49] We applied CCS codes to all ICD-9 codes listed on all beneficiary inpatient and outpatient claims in 2010. If a beneficiary had 2 or more outpatient claims or 1 or more inpatient claims listing of a particular disease or condition of interest (defined in the next paragraph) they were categorized as having that illness, consistent with criteria used in previous studies.[50]

We identified chronic diseases that were relevant to our research question and population of interest. We first flagged chronic conditions identified as major cause of ED visits in the Nationwide Emergency Nationwide Emergency Department Sample (NEDS), which included hypertension, hyperlipidemia, diabetes, chronic obstructive pulmonary disease (COPD), mental illness/substance abuse, congestive heart failure (CHF), other heart

disease, and dementia.[46] We also included diagnoses of chronic kidney disease (CKD) and arthritis, as these diseases are both prevalent and costly in the Medicare population.[47],[48]

Other clinical variables included in the analysis were HCC scores and original reason for Medicare entitlement. At the contextual level, the percentage of beneficiaries with ED visits and the percentage of beneficiaries with primary care visits in the PCSA were used to characterize the clinical profile of the community in which beneficiaries reside.

Dependent Variables

ED visits: ED visits were identified from the inpatient file (for those treated in the emergency room and subsequently admitted to the hospital) and outpatient file (for those treated in the ED and then released). Both types of ED claims can be identified by Revenue Center Codes 0450-0459 and 0981.[51] Revenue center codes indicate the final claims paid by CMS, and are more reliable than "source of admission" codes, which are recorded by various clinical staff and not used for reimbursement purposes.[42] We eliminated duplicate claims by creating a variable for each beneficiary and date combination, and deleting claims that were within a 1-day period for the same beneficiary, then developed a count variable for the number of ED visits in 2010.

Frequent ED Use: We assigned beneficiaries to frequent ED user categories based on the count of ED visits in 2010. Frequent ED use referred to 4 or more visits in a calendar year, following previously defined cut-points.[3],[4],[10] Beneficiaries with no ED visits in 2010 were considered non-ED users while those with 1-3 visits were classified as infrequent ED users.

Statistical Analysis

We first examined the distribution of Medicare beneficiaries within the 3 categories of non-, infrequent, and frequent ED use in 2010. We made comparisons of sociodemographic, primary care, and clinical characteristics among the different types of ED

users using chi-squared statistics for categorical variables and ANOVA for continuous variables. Next, bivariate and multivariate multinomial logistic regression was used to determine the relative risk ratio of being a frequent ED user compared a non-ED user or infrequent ED user in 2010. The multinomial logistic regression model is an extension of the simple logistic regression model for dichotomous dependent variables that applies to discrete, nominal, and unordered poltytomous dependent variables.[54] Unlike ordinal logistic regression models, multinomial models do not assume proportional odds for being in each category higher than the base category and instead estimate separate equations for each category compared to the base category.[55] Because we had no prior evidence to support proportional odds of frequent versus non-ED use and frequent versus infrequent ED use, we opted for the more flexible multinomial model. As in the case of the simple logistic regression, maximum likelihood estimation (MLE) is used since the normality assumption of ordinary least squared (OLS) regression is violated.[54] We used robust standard errors to account for beneficiary clustering at the PCSA level and Wald tests were used to evaluate the significance of regression coefficients.[57] All descriptive analysis was conducted using SAS Enterprise Guide 5.1 and regression analysis was performed in STATA 12.1.[58,59]

We grouped independent variables into 3 categories: sociodemographic (predisposing), primary care (enabling) and clinical (need). Because of our overarching interest in primary care factors, we first constructed a model using primary care variables only, then sequentially incorporated sociodemographic and clinical variables individually and together to determine the sensitivity of the original relative risk ratios to the inclusion of other controls. We also compared the Akaike Information Criteria (AIC) scores of the fuller models versus the parsimonious models. The AIC values, displayed in Table 13,

demonstrated that a model containing all sociodemographic, primary care, and clinical variables was best suited to the data. For ease in interpreting relative risk ratios, we standardized all continuous variables.

Table 13: Model Selection - Cross Sectional Analysis	
Model	**AIC**
Non-Users as Reference Group	
Primary Care-Level Factors Only	7775338
Primary Care and Sociodemographic Factors	7421030
Primary Care and Clinical Factors	6584672
All Statistically Significant in Bivariate Analysis	6457477
Full Model, All Variables	6457447
Infrequent Users as Reference Group	
Primary Care-Level Factors Only	7775338
Primary Care and Sociodemographic Factors	7421030
Primary Care and Clinical Factors	6584672
All Statistically Significant in Bivariate Analysis	6466918
Full Model, All Variables	6457447

Results

The majority (70.93%) of FFS Medicare beneficiaries that survived 2010 did not incur any ED visits. Roughly one-quarter of FFS Medicare beneficiaries had 1-3 visits (25.77%) and were therefore characterized as infrequent ED users. Frequent ED users comprised 3.30% of the sample. The baseline characteristics of non-ED users, infrequent ED users, and frequent ED users in 2010 are displayed in Table 14.

Frequent ED users in 2010 were skewed toward younger ages and the oldest old (85+) and toward minority and non-white race and ethnicity. More than half (51.65%) of frequent ED users were enrolled in Medicaid coverage in 2010 compared to 16.09% of non-ED users and 26.75% of infrequent ED users. There was a median income differential of approximately $4000 between non-ED users and frequent ED users, with frequent ED users

Table 14: Baseline Statistics, Cross-Sectional Analysis*				
	Non-Users (0 Visits)	**Infrequent Users (1-3 Visits)**	**Frequent Users (4+ Visits)**	**Total**
	n=4,098,450	n=1,488,993	n=190,595	n=5,778,038
Sociodemographic Characteristics	70.93	25.77	3.30	100.00
Age				
18-34	1.33	2.21	6.42	1.72
35-44	2.13	3.47	8.94	2.70
45-54	4.60	6.94	14.44	5.53
55-64	7.06	9.01	13.37	7.77
65-74	45.63	31.88	20.97	41.28
75-84	28.72	29.81	21.48	28.77
85+	10.52	16.67	14.38	12.23
Gender				
Male	45.54	41.85	41.15	44.44
Female	54.46	58.15	58.85	55.56
Race				
Caucasian	82.22	79.95	72.06	81.30
African-American	8.34	11.54	18.59	9.50
Asian/Pacific Islander	2.48	1.54	0.97	2.19
Hispanic	5.41	5.69	6.81	5.53
Native American	0.48	0.51	0.90	0.50
Other/Unknown	1.07	0.78	0.66	0.98
Medicaid Eligibility				
0 Months	83.91	73.25	48.35	79.99
1-12 Months	16.09	26.75	51.65	20.01
Percent Elderly in PCSA (Mean, SD)	4.70	4.52	4.14	4.64

Table 14: Baseline Statistics, Cross-Sectional Analysis*				
	Non-Users (0 Visits)	**Infrequent Users (1-3 Visits)**	**Frequent Users (4+ Visits)**	**Total**
Percent Black in PCSA (Mean, SD)	14.94	15.81	17.15	15.25
Percent Hispanic in PCSA (Mean, SD)	15.77	15.38	15.72	15.67
Median Income in PCSA (Mean, SD)	$17,584	$16,983	$15,707	$17,387
Primary Care Characteristics				
Usual Provider				
Generalist	23.91	27.88	28.18	25.07
Specialist	39.29	52.66	56.61	43.31
No Usual Provider	36.80	19.46	15.22	31.62
Continuity of Care Category				
No COC (<3 physician visits in 2010)	36.80	19.46	15.22	31.62
Low	19.72	26.96	31.39	21.97
Medium	22.34	29.15	29.95	24.35
High	21.14	24.43	23.44	22.06
Continuity of Care Index, 2010 (Mean, SD)	0.32	0.28	0.25	0.31
Number included in Calculation				
Number of Physician Visits in 2010 (Mean, SD)	5.67	7.26	9.16	6.48
Primary Care Physicians/1000 in PCSA, 2007 (Mean, SD)	0.42	0.42	0.43	0.42
Community Health Centers/1000 in PCSA, 2007 (Mean, SD)	0.14	0.14	0.13	0.14
Clinical Characteristics				
Original Reason for Medicare Entitlement				
Aged	78.52	69.18	44.98	75.00
Disabled without ESRD	21.07	29.70	51.39	24.29
ESRD only	0.16	0.40	1.28	0.26
Disabed with ESRD	0.26	0.73	2.34	0.45

Table 14: Baseline Statistics, Cross-Sectional Analysis*				
	Non-Users (0 Visits)	**Infrequent Users (1-3 Visits)**	**Frequent Users (4+ Visits)**	**Total**
Chronic Disease				
Congestive Heart Failure				
No	96.90	85.93	68.77	93.15
Yes	3.10	14.07	31.23	6.85
Other Heart Disease				
No	74.97	44.36	24.85	65.43
Yes	25.03	55.64	75.15	34.57
Chronic Obstructive Pulmonary Disease				
No	93.82	82.15	64.55	89.84
Yes	6.18	17.85	35.45	10.16
Hyperlipidemia				
No	55.50	46.81	45.51	52.93
Yes	44.50	53.19	54.49	47.07
Hypertension				
No	50.94	28.78	20.42	44.22
Yes	49.06	71.22	79.58	55.78
Chronic Kidney Disease				
No	93.06	79.11	62.02	88.45
Yes	6.94	20.89	37.98	11.55
Mental Illness				
No	89.52	70.88	37.74	83.01
Yes	10.48	29.12	62.26	16.99
Diabetes				
No	77.17	6.72	56.92	73.93

Table 14: Baseline Statistics, Cross-Sectional Analysis*				
	Non-Users (0 Visits)	**Infrequent Users (1-3 Visits)**	**Frequent Users (4+ Visits)**	**Total**
Yes	22.83	32.81	43.08	26.07
Dementia				
No	98.03	91.65	84.16	95.93
Yes	1.97	8.35	15.84	4.07
Arthritis				
No	77.62	60.54	45.34	72.15
Yes	22.38	39.46	54.66	27.85
HCC Score (Mean, SD)	0.73	1.07	1.56	0.91
ED Visit Rate in PCSA, 2005 (Mean, SD)	66.62	63.06	55.78	65.39
PCP Visit Rate in PCSA, 2005 (Mean, SD)	22.11	20.23	19.41	21.55
*All Results Statistically Significant at .05 level				

living in less affluent geographic regions ($50,910 versus $54,067, respectively, measured in 2008). Frequent ED users also tended to live in communities with more African-American residents.

Continuity of care across primary care visits was inversely proportional to ED use. Frequent ED users had a lower mean COCI (0.31) compared to non-ED users (0.37), and a larger percentage of frequent ED users fell into the category of low continuity. Frequent ED users incurred twice as many physician visits in 2010 than non-ED users (11 versus 5), and more than infrequent ED users (9). The percentage of beneficiaries with no usual provider was highest in the group of non-ED users, while having a specialist as a PCP was most common among frequent ED users. The availability of PCPs and community health centers in the PCSA did not differ across the 3 ED user groups.

Frequent ED users were more likely to be identified as having each of the chronic conditions that were examined. They also were found to be at greater risk for heavy use of future health services given their higher mean HCC scores (2.04 compared to 0.89 in non-ED users and 1.31 in infrequent ED users). A larger percentage of frequent ED users originally qualified for Medicare due to disability, ESRD, or both. While the rate of PCP visits in the PCSA did not differ among the 3 ED user groups, frequent ED users lived in PCSAs with a higher mean rate of ED visits in 2005. The bivariate multinomial logistic regression results, displayed in Table 4, were largely consistent with stratified analyses.

The results from the full multivariate multinomial model are displayed in Table 5. While most of the variables studied achieved statistical significance, some factors were more strongly associated with the relative risk of frequent ED use. Younger beneficiaries as well as the oldest old had greater relative risk of frequent ED use compared to non-ED user. Most notably, beneficiaries less than 35 years of age were 16 times as likely as 65-74 year-

Table 15: Bivariate Multinomial Logistic Regression Results, Cross-Sectional Analysis						
	Frequent vs. Non-Users			Frequent vs. Infrequent Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
Sociodemographic (Predisposing Characteristics)						
AGE						
18-34	10.50	10.21	10.77	4.42	4.30	4.53
35-44	9.16	8.93	9.38	3.92	3.83	4.00
45-54	6.83	6.69	6.97	3.16	3.10	3.23
55-64	4.12	4.03	4.20	2.26	2.21	2.30
65-74	1.00			1.00		
75-84	1.63	1.60	1.65	1.10	1.08	1.11
85+	2.97	2.91	3.04	1.31	1.29	1.34
GENDER						
Male	1.00			1.00		
Female	1.20	1.18	1.21	1.03	1.02	1.04
RACE						
White	1.00			1.00		
Black	2.54	2.48	2.61	1.79	1.76	1.82
Asian	0.45	0.42	0.48	0.70	0.66	0.74
Hispanic	1.44	1.38	1.49	1.33	1.29	1.37
Native American	2.14	1.90	2.41	1.97	1.86	2.09
Unknown/Other	0.71	0.67	0.75	0.95*	0.89	1.00
MEDICAID	5.57	5.42	5.72	2.93	2.88	2.97
% ELDERLY IN PCSA (Standardized)	0.95	0.93	0.96	0.94	0.93	0.95
% BLACK IN PCSA (Standardized)	1.14	1.12	1.15	1.09	1.08	1.09
% HISPANIC IN PCSA (Standardized)	0.96	0.95	0.98	1.00*	0.99	1.01
MEDIAN INCOME IN PCSA (Standardized)	0.82	0.80	0.83	0.88	0.87	0.89
Primary Care (Enabling Characteristics)						
CONTINUITY OF CARE						
High	1.00					

Medium	1.21	1.19	1.23	1.07	1.06	1.09
Low	1.43	1.41	1.46	1.21	1.19	1.23
No Score (<3 Physician Visits in 2010)	0.37	0.36	0.38	0.82	0.80	0.83
PCP AS USUAL PROVIDER	0.73	0.73	0.74	0.92	0.92	0.93
PHYSICIAN VISITS IN 2010 (Standardized)	1.66	1.64	1.68	1.24	1.24	1.25
PCPS/1000 IN PCSA (Standardized)	0.99*	0.97	1.01	1.00*	0.99	1.01
CHCS/1000 IN PCSA (Standardized)	1.02	1.01	1.03	1.01	1.00	1.01
Clinical (Need Characteristics)						
ENTITLEMENT REASON						
Old Age	1.00			1.00		
Disability	4.26	4.12	4.32	2.66	2.63	2.79
ESRD	14.10	13.47	14.91	4.94	4.70	5.19
Disability and ESRD	15.97	15.38	16.58	4.95	4.77	5.13
HYPERLIPIDEMIA	1.49	1.47	1.52	1.05	1.04	1.07
HYPERTENTION	4.05	3.98	4.12	1.57	1.55	1.60
OTHER HEART DISEASE	9.06	8.90	9.21	2.41	2.38	2.44
CONGESTIVE HEART FAILURE	14.21	13.95	14.47	2.78	2.74	2.81
COPD	8.33	8.22	8.44	2.53	2.50	2.56
DEMENTIA	9.36	9.18	9.54	2.07	2.03	2.10
DIABETES	2.56	2.53	2.59	1.55	1.53	1.57
ARTHRITIS	4.18	4.13	4.24	1.85	1.83	1.87
MENTAL ILLNESS	14.09	13.89	14.29	4.02	3.97	4.06
CHRONIC KIDNEY DISEASE	8.21	8.09	8.34	2.32	2.30	2.35
HCC SCORE (Standardized)	2.27	2.25	2.28	1.37	1.37	1.38
PCP VISIT RATE IN PCSA, 2005 (Standardized)	1.01	1.00	1.02	1.00*	0.99	1.00
ED VISIT RATE IN PCSA, 2005 (Standardized)	1.05	1.04	1.06	1.03	1.02	1.04
*Not Statistically Significant at .05 level						

Table 16: Multivariate Multinomial Logistic Regression Results, Cross-Sectional Analysis						
	Infrequent vs. Non-Users			Frequent vs. Non-Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
Sociodemographic (Predisposing Characteristics)						
AGE						
18-34	15.99	15.42	16.58	6.16	5.96	6.37
35-44	8.49	8.21	8.78	4.06	3.94	4.18
45-54	3.92	3.82	4.03	2.43	2.37	2.49
55-64	1.68	1.64	1.72	1.41	1.38	1.44
65-74	1.00					
75-84	1.09	1.07	1.11	0.96	0.95	0.98
85+	1.60	1.57	1.64	1.08	1.05	1.10
GENDER						
Male	1.00			1.00		
Female	1.21	1.19	1.23	1.06	1.05	1.07
RACE						
White	1.00			1.00		
Black	1.96	1.89	2.03	1.39	1.37	1.43
Asian	0.55	0.49	0.62	0.78	0.73	0.84
Hispanic	1.36	1.25	1.49	1.15	1.08	1.21
Native American	1.21	1.05	1.40	1.36	1.26	1.45
Unknown/Other	0.76	0.69	0.83	0.86	0.80	0.93
MEDICAID	2.04	1.96	2.13	1.53	1.05	1.07
% ELDERLY IN PCSA (Standardized)	0.91	0.89	0.93	0.95	0.93	0.96
% BLACK IN PCSA (Standardized)	0.87	0.85	0.89	0.94	0.92	0.95
% HISPANIC IN PCSA (Standardized)	0.81	0.79	0.83	0.91	0.89	0.92
MEDIAN INCOME IN PCSA (Standardized)	0.88	0.86	0.90	0.93	0.92	0.95
Primary Care (Enabling Characteristics)						
CONTINUITY OF CARE						
High	1.00			1.00		

Table 16: Multivariate Multinomial Logistic Regression Results, Cross-Sectional Analysis						
	Infrequent vs. Non-Users			Frequent vs. Non-Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
Medium	1.13	1.11	1.15	1.05	1.04	1.07
Low	1.26	1.23	1.28	1.13	1.12	1.15
No Score	1.09	1.03	1.15	1.13	1.07	1.18
PCP AS USUAL PROVIDER	1.02	1.00	1.03	1.03	1.01	1.04
PHYSICIAN VISITS IN 2010 (Standardized)	1.29	1.27	1.31	1.13	1.12	1.14
PCPS/1000 IN PCSA (Standardized)	1.02*	1.00	1.03	1.02	1.00	1.02
CHCS/1000 IN PCSA (Standardized)	1.06	1.05	1.08	1.03	1.02	1.04
Clinical (Need Characteristics)						
MEDICARE ENTITLEMENT REASON						
Old Age	1.00			1.00		
Disability	1.54	1.50	1.58	1.24	1.21	1.27
ESRD	1.57	1.46	1.68	1.24	1.17	1.32
Disability and ESRD	1.36	1.29	1.43	1.09	1.04	1.14
HYPERLIPIDEMIA	0.76	0.75	0.77	0.92	0.90	0.93
HYPERTENTION	2.04	2.00	2.07	1.30	1.28	1.33
OTHER HEART DISEASE	5.21	5.12	5.30	2.08	2.05	2.11
CONGESTIVE HEART FAILURE	3.01	2.95	3.07	1.66	1.63	1.68
COPD	2.73	2.68	2.79	1.55	1.52	1.57
DEMENTIA	5.82	5.68	5.98	1.98	1.94	2.01
DIABETES	1.14	1.12	1.16	1.07	1.05	1.08
ARTHRITIS	2.26	2.22	2.30	1.49	1.47	1.51
MENTAL ILLNESS	5.96	5.86	6.07	2.56	2.52	2.59
CHRONIC KIDNEY DISEASE	3.32	3.27	3.37	1.64	1.62	1.66
HCC SCORE (Standardized)	1.22	1.21	1.22	1.18	1.18	1.19
PCP VISIT RATE IN PCSA, 2005 (Standardized)	1.01*	0.99	1.02	1.00*	0.99	1.01
ED VISIT RATE IN PCSA, 2005 (Standardized)	1.02	1.01	1.03	1.01	1.00	1.02
*Not statistically significant at 0.05 level						

olds to be frequent ED users versus non-users. Women had 21% greater relative risk than men of being frequent ED users compared to non-ED users. Black, Hispanic, and Native American beneficiaries were more likely to be frequent ED users, with blacks having twice the relative risk of frequent ED use versus non-ED use. Medicaid eligibility was associated with over 2 times the relative risk of frequent ED use compared to non-ED use.

In terms of primary care characteristics, continuity of care was again inversely associated with frequent ED use. Beneficiaries with low COC were 26% more likely than those with high COCI to incur frequent ED use compared versus non-ED use. Frequent ED users were also heavy users of physician services, as seen in the 29% greater relative risk of frequent compared to non-ED use for each standard deviation increase in physician visits in 2010.

Clinical factors were most strongly associated with frequent ED use. Disabled beneficiaries and those with ESRD as an original reason for Medicare entitlement had higher relative risk of frequent ED use versus non-ED use and infrequent ED use compared to those who qualified for Medicare due to old age. Each standard deviation increase in HCC was associated with a 22% increase in relative risk of frequent ED use versus non-ED use. All chronic diseases with the exception of hyperlipidemia were associated with higher relative risk of frequent ED use. Of particular note were the strong associations between heart disease (RRR 5.21, CI 5.12-5.30), congestive heart failure (RRR 3.01, CI 2.95-3.07), dementia (RRR 5.82, CI 5.82-5.68), mental illness (RRR 5.96, CI 5.86-6.07) and chronic kidney disease (RRR 3.32, CI 3.27-3.37) and frequent ED use.

Discussion

Frequent ED users comprise less than 4% of FFS Medicare beneficiaries. They are more likely than non-ED users and infrequent ED users to be African-American and Medicaid eligible consistent with previous findings.[4,21] Also in line with prior research, the health status of frequent ED users was worse than non-ED users and infrequent ED users, as demonstrated in disability, chronic disease diagnoses, and HCC scores.[3,12], As observed in other studies, frequent ED users rely heavily on other healthcare services, as illustrated in the fact that they averaged more than 11 physician visits per year.[6,7] Previous research has been mixed in terms of age and gender effects. In this sample, younger and female beneficiaries had greater relative risk of frequent ED use. The youngest group of disabled beneficiaries, those aged 18-34, had nearly 11 times the risk of frequent of frequent ED use, the strongest effect observed in this analysis. .

This paper offers greater perspective into frequent ED use in the Medicare population by identifying specifically which sociodemographic and clinical factors are associated with frequent ED use, and suggesting the potential benefit of continuity of care in reducing ED use. Disabled Medicare beneficiaries under age 65 and those with congestive heart failure, other heart diseases, COPD, CKD, dementia and mental illness are particularly likely to incur frequent ED use. Low continuity of care was associated with greater relative risk of frequent ED use by 26%. This is consistent with the only previous article that looked at a form of continuity of care with respect to frequent ED use. In that study, Hunt and colleagues found that Community Tracking Survey respondents who reported seeing the same physician at every outpatient visit were 33% less likely to be frequent ED users than those who saw different physicians.[4]

These findings illuminate the important point that frequent ED users are not merely using the ED as a substitute for primary care. Simply put, frequent ED users are frequent

users of all healthcare services, both inpatient and outpatient. This phenomenon is a reflection of the social vulnerability and poor health status of frequent ED users. Even when controlling for health system level variables, younger sicker beneficiaries are more likely to repeatedly seek emergency care. Thus, efforts that target reduction of frequent ED use in Medicare will require a broad-based approach that necessarily targets both providers and patients.

The implications of this research for CMS are threefold. First, physicians who serve the Medicare population should be especially attentive to chronic diseases that increase the odds of frequent ED use, specifically heart disease, CKD, dementia, and mental illness, particularly in younger Medicare beneficiaries. If physicians are aware of these risk factors, they can devote more attention to preventing and managing these conditions in their patients through medication, lifestyle changes, and other evidence-based interventions.

Secondly, the elevated risk of frequent ED use among disabled beneficiaries under age 65 implies that there are unmet needs in this population that must be addressed. While younger beneficiaries comprised a small proportion of the sample studied, they accounted for a disproportionate share of frequent ED users. More research is needed to understand the clinical profile and gaps in care among this vulnerable population in order to educate Medicare providers about unique challenges that may not apply to elderly enrollees.

Thirdly, the effect of continuity of care on the odds of frequent ED use suggests that CMS should encourage coordination and collaboration among providers. By adequately compensating physicians to take on more responsibilities, CMS can direct beneficiaries to their usual provider for more visits without having to seek help from many specialists. Additionally, making communication with other physicians a billable service by adding a care coordination benefit will entice doctors to coordinate with one another to better serve

patients. Both incentives would promote a comprehensive approach to care management for a multi-morbid aging population.

There are several limitations to acknowledge with this research design. First, since claims are not collected for the purposes of research, any secondary analysis is restricted to what is specifically noted in Medicare billing and demographic files. Therefore, this study lacked measures of patient-reported outcomes and clinical values that could have offered a more complete understanding of why some beneficiaries become frequent ED users. Second, the retrospective nature of this analysis precludes us from making definite causal arguments. Third, with Medicare Advantage enrollees and deceased beneficiaries excluded, the generalizability of the findings is constrained to FFS beneficiaries who survived through 2010.

Despite these limitations, this paper provides new insight and confirms previous findings relevant to the majority of Medicare beneficiaries. Frequent ED use is largely a reflection of poorly controlled chronic disease and, to a lesser extent, a fragmented primary care system and socioeconomic disparities. A comprehensive, long-term strategy for reducing frequent ED use would address all three areas, but in the meantime focusing on management of the chronic diseases that increase a person's risk of frequent ED use is the most appropriate course of action.

Chapter 4: Manuscript 3

Understanding Frequent Emergency Department Use over Time in the Medicare Population

ABSTRACT

Context: Frequent emergency department (ED) use is a serious public health problem. While frequent emergency department (ED) use has been widely researched in cross-sectional studies in the general population, there is a dearth of studies with longer time horizons and representative sample of Medicare beneficiaries.

Objective: To examine factors associated with frequent ED use over a 2-year period among Medicare beneficiaries

Study Design: This was retrospective, claims-based analysis of FFS Medicare beneficiaries using a 20% sample from the Chronic Condition Warehouse and other linked sources. Beneficiary and communities characteristics as well as frequent ED use in 2009 were studied in relation to frequent ED use (defined as 4 or more ED visits) compared to infrequent (1-3 visits) and non-ED use in 2010. In this article, we describe the persistence of frequent ED use during a 2-year period, comparing those with 2 consecutive years of frequent ED use (persistent frequent ED users) to those with 1 year of frequent ED use (occasional frequent ED users), 1-3 visits in either 2009 and 2010 (infrequent ED users), and no visits in either 2009 or 2010 (non-ED users). We use multinomial logistic regression and transition models to determine the relative risk of persistence of frequent ED use in 2010.

Principle Findings: Approximately 1 percent (1.16%) of Medicare beneficiaries incurred 4 or more ED visits in both 2009 and 2010. While approximately 3% of Medicare beneficiaries incurred 4 or more ED visits in 2009, the majority of these beneficiaries were non-ED users (20.90%) or infrequent ED users (42.05) of the ED in 2010. Frequent ED

use in 2009 was highly associated with frequent ED use in 2010 with an adjusted relative risk ratio of 23.96 compared to non-users. Beneficiaries aged 18-34 had more than 6 times the relative risk of frequent ED use versus non-use in 2010 compared to beneficiaries aged 65-74, and those with mental illness had nearly 3 times the relative risk of frequent ED use versus non-ED use. Among those who were frequent ED users in 2009, the probability of frequent ED use in 2010 was 34% for the youngest beneficiaries, 23% for the mentally ill, and 45% for the young and mentally ill compared to a population average of just 3%.

Conclusion and Policy Implication: Younger, mentally ill Medicare beneficiaries are at greater risk for persistent frequent ED use than elderly beneficiaries. Medicare providers need to be made aware of the needs of this vulnerable population and work to improve the quality of care for these beneficiaries to alleviate their reliance on the ED.

Introduction

The issue of frequent emergency department (ED) use is of great practical and policy significance with quality, cost, and human implications. Despite representing only 8% of ED patients, people who use the ED 4 or more times in one-year (frequent ED users) account for 28% of all ED visits in the US. [3,4] Frequent ED users tend to incur more resource-intensive ED visits.[3,5,6] The issue of frequent ED use is of particular concern in the Medicare population, as Medicare beneficiaries are nearly twice as likely as privately insured individuals to be frequent ED users.[4]

No previous studies have specifically focused on frequent ED use among Medicare beneficiaries. However, consistent findings from a growing evidence base indicate sociodemographic, clinical, and health system level factors that contribute to frequent ED use. These three levels of determinants coincide with predisposing, enabling, and need

variables in the Anderson model of health utilization.[11] Minority race, high educational attainment, low income, public insurance, a usual source of care, high utilization of outpatient healthcare resources, and poor physical and mental health are all associated with greater odds of frequent ED use (See Chapter 2).

In a recently published literature review and expert consensus, Jesse Pines and colleagues identified several gaps in the public health and medical literature on frequent ED use. [24] The first major challenge to coherently synthesizing results from research conducted to date on frequent ED use is the lack of a meaningful categorization of frequent ED users in a given year as well as longitudinally across time. The authors call for a more meaningful taxonomy to describe frequent ED use based not only on frequency but also patterns such as long-term, short-term and periodic use. A person who is considered a frequent ED user in one year may not necessarily be a frequent ED user the following year, and in fact several authors have observed regression to the mean in the year following a year of frequent ED use.[6],[18],[21]

This article contributes to the literature on frequent ED use by providing the first estimates of the prevalence of persistent frequent ED use among Medicare beneficiaries. This work will help identify a population of users that are in greatest need of targeted interventions. The goal of this article is to provide health services researchers and policy-makers with a better understanding of potentially modifiable factors that affect the persistence of frequent ED use among Medicare beneficiaries in order to guide future studies and inform the development of clinical innovations and public policies.

Methodology

Study Design and Sample

This study was a retrospective analysis of secondary administrative claims of a random 20% sample of Medicare beneficiaries for calendar years 2009-2010. All beneficiaries living in the community and continuously enrolled in Medicare Parts A and B throughout 2009 and 2010 were included. Beneficiaries with one month or more of Medicare Advantage (MA) coverage or disenrollment from Medicare Parts A and B, or 3 or more months of nursing home placement during the study period, were eliminated from consideration, as were those who died in 2009 or 2010. After excluding beneficiaries who did not meet eligibility criteria (n=4,633,692), we were left with a sample size of 5,186,523. As illustrated in Table 5 (See Chapter 2, page 30), Medicare beneficiaries who were included in our study sample were statistically significantly more likely to be younger than 55 or 75-84 years old, female, white, or entitled to Medicare on the basis of disability than those who were excluded. Individuals age 65-74, older than 85 years, or characterized as Hispanic were more likely to be excluded

Data Sources

This study draws on several linked data sources, including administrative claims and socio-demographic information from the Chronic Condition Data Warehouse (CCW), beneficiary-level hierarchical categorical condition (HCC) scores and timeline files from internal CMS records, and market-level characteristics from the Dartmouth Atlas. The CCW includes fee-for-service billing history for services reimbursed under Medicare Parts A, B and D as well as data regarding beneficiary demographic characteristics.[38] HCC scores are measures of predicted utilization used by CMS to risk adjust reimbursement to managed care plans.[39] The timeline file lists the type of residence of a beneficiary on each day of a calendar year. A flag is included for every day from 1-366 which indicates whether the beneficiary was in the community, inpatient hospital, skilled nursing facility, or residential nursing

facility. Beneficiaries with 3 more months of nursing home stays are assigned an institutional flag that is used to calculate their HCC score. We used the same standard to indicate institutionalized beneficiaries, who were then excluded from our sample.

The Dartmouth Atlas provides data on the socio-demographic and clinical characteristics of a population as well the availability of healthcare resources in a particular geographic region.[40] The smallest unit of analysis is the Primary Care Service Areas (PCSA). There are 6,542 PCSAs nationally, which are defined by aggregating ZIP areas to reflect Medicare patient travel to primary care providers.[41] No PCSA-level information is available for US territories, thus we excluded beneficiaries living outside the 50 US states. We merged Dartmouth Atlas variables with the CCW by matching beneficiary zip codes with information from the corresponding PCSA, using publically available crosswalk files.

Independent Variables

Socio-demographic Characteristics**:** We examined beneficiary age, gender, race, and Medicaid eligibility. Beneficiary age at the end of calendar year 2009 was categorized as 18-34 and in 10-year blocks from ages 35 to 85 and older. We used the Research Triangle Institute (RTI) race code in the BSF because prior research has demonstrated that it captures more beneficiaries of Hispanic ethnicity due it its more inclusive criteria for finding Spanish surnames.[42] Any beneficiary with at least one month of Medicaid enrollment during the baseline year 2009 was considered to be Medicaid eligible in these analyses. At the contextual level, we examined PCSA-level measures, including percent African-American, Hispanic, 65 or older, and median income. These contextual factors were used to control for geographic effects that may influence frequent ED use.

Primary Care Characteristics: We measured continuity of care using the Continuity of Care Index (COCI). The COCI is a continuous measure of dispersion of outpatient

evaluation and management (E&M) visits over a period of time. COCI is a function of how many outpatient E&M appointments a patient incurs in relation to unique doctors from who they receive care.[29] The CoCI Index was calculated in both 2009 and 2010. We converted the CoCI into a categorical variable in each year based on the distribution of scores and classified beneficiaries into tertiles, termed here as "low" (less than or equal to 0.18), "medium" (0.19-0.32), or "high" (greater than or equal to 0.33) continuity. A recently published study suggests CoC index is only valid among individuals with 3 or more E&M visits in the reference year.[43] Therefore, to retain beneficiaries without a valid COCI score in our study sample, we created a 4th category of COCI for those with fewer than 3 E&M visits. We also counted the overall number of physician visits in which an evaluation and management code was incurred in 2009 and 2010 as measure of healthcare utilization outside the ED.

Primary care was also examined as a contextual factor. Using the Dartmouth Atlas, we identified the number of primary care physicians and community health centers (CHCs), including Federally Qualified Health Centers (FQHCs) and CMS-certified Rural Health Centers, in each participant's PCSA. We then standardized this information to construct a PCSA-level marker of beneficiaries' access to primary care services, on the basis of number of PCPs and CHCs in relation to the number of individuals residing in the PCSA geographic region, per 1000 population.

Clinical Characteristics: Chronic disease diagnoses were assigned using the Clinical Classification Software (CCS), developed by the Agency for Healthcare Research and Quality (AHRQ) for the Healthcare Cost and Utilization Project (HCUP). The CCS aggregates more than 14,000 ICD-9-CM diagnosis codes and 3,900 procedure codes into a smaller number of clinically meaningful categories that are easier to analyze and interpret.[49] We applied CCS

codes to all ICD-9 codes listed on beneficiary inpatient and outpatient claims. If a beneficiary incurred 2 or more outpatient claims or 1 or more inpatient claims listing of a particular disease or condition of interest (defined in the next paragraph) in a 1-year period, they were counted as having that illness, consistent with criteria used in previous studies.[50]

We first constructed measures for chronic conditions identified as major cause of ED visits in the Nationwide Emergency Nationwide Emergency Department Sample (NEDS), which included hypertension, hyperlipidemia, diabetes, chronic obstructive pulmonary disease (COPD), mental illness/substance abuse, congestive heart failure (CHF), other heart disease, and dementia. [46] We also constructed measures for chronic kidney disease (CKD) and arthritis, as these diseases are both prevalent and costly in the Medicare population. [47],[48]

Other clinical variables included HCC scores and the original reason beneficiary Medicare entitlement. At the contextual level, the percentage of beneficiaries with ED visits and the percentage of beneficiaries with primary care visits in the PCSA were used to characterize the community in which beneficiaries reside.

Dependent Variables

ED visits: ED visits were identified from inpatient and outpatient administrative claims. Billing claims for Medicare beneficiaries treated in the emergency room and admitted to the hospital are included in the inpatient file, whereas billing claims for beneficiaries treated in the ED but released are represented in the outpatient file.[51] Revenue Center Codes 0450-0459 and 0981 can identify both types of ED claims. Revenue center codes indicate the final claims paid by CMS, and are more reliable than "source of admission" codes, which are recorded by various clinical staff and not used for reimbursement purposes.[42] We eliminated duplicate claims for each beneficiary and date

combination and constructed a count variable of the number of ED visits incurred in 2009 and 2010.

Frequent ED Use: We assigned beneficiaries to frequent ED user categories based on the count of ED visits in 2009 and 2010. Following previously established cut-points, frequent ED use referred to 4 or more visits in any calendar year.[3,4,10] For descriptive analyses, frequent ED users were further categorized by the persistence of frequent ED use during the 2-year study period. Beneficiaries with 4 or more visits in both years were categorized "persistent" frequent ED users. Beneficiaries with one year of frequent ED use were categorized "episodic" frequent ED users. Those with no ED visits during the study period were categorized as "non-ED users", while those with 1-3 visits in at least one of the study years were categorized as "infrequent" ED users.

Statistical Analysis

We first examined the distribution of Medicare beneficiaries by category of persistent frequent ED use during 2009-2010, and identified statistically significant differences between these groups using chi-squared statistics for categorical variables and ANOVA for continuous variables. Next, we conducted a multinomial logistic regression using a transitional model to predict frequent ED use in 2010. The multinomial logistic regression model is an extension of the simple logistic regression model for dichotomous dependent variables that applies to discrete, nominal, and unordered poltytomous dependent variables.[54] We used a multinomial model, which does not assume proportional odds for being in each category higher than the reference group and instead estimates separate equations for each category compared to the base.[55] While ED visit categories may be considered ordinal, we have no empirical basis to assume proportional odds by level of ED utilization and thus opted for the more flexible multinomial approach. As in the case of the

simple logistic regression, maximum likelihood estimation (MLE) is used as the normality assumption of ordinary least squared (OLS) regression is violated.[54]

Transition models describe the conditional distribution of the dependent variable as an explicit function of its previous values and a set of covariates.[56] In this case, we calculated the relative risk ratio of frequent ED use in 2010 as a function of frequent ED use in 2009 and sociodemographic, primary care, and clinical factors as previously described. We also estimated the marginal probability of frequent ED use in 2010 contingent on certain values of select independent variables with the strongest association with frequent ED use, with all other variables held at their mean.

Continuous variables were standardized for ease in interpreting relative risk ratios. Physician visits were dichotomized by fewer than 5 visits per year or 5+ visits per year, based on previous literature.[4,7] Wald tests were used to test the significance of regression coefficients. We used robust estimates of standard errors to account for beneficiary clustering at the PCSA level. This "sandwich estimator" controls for within-cluster correlation when the independence assumption of traditional linear models is violated.[57] We first ran models containing only the primary care level variables, then added sociodemographic and clinical variables in succession and compared the Akaike Information Criterion scores of full versus parsimonious models. As seen in Table 17, the full models with all predictors were best suited to the data. Data management and descriptive statistics were conducted using SAS Enterprise Guide 5.1 software; bivariate and multivariate multinomial logistic regression and Markov analyses were conducted in STATA 12.[58,59]

Results

Frequent ED use was a relatively rare and temporary phenomenon in the Medicare population between 2009 and 2010. As demonstrated in Table 11 (See Chapter 2, page 40),

Table 17: Model Selection, Longitudinal Analysis	
Non-Users as Reference Group	
Model	**AIC Score**
Primary Care Variables Only	6633859
Primary Care + Clinical Variables	6059737
Primary Care + Sociodemographic Variables	6479001
Significant in Bivariate Only	5996283
Full Model	5995657
Infrequent Users as Reference Group	
Model	**AIC Score**
Primary Care Variables Only	6633859
Primary Care + Clinical Variables	6059737
Primary Care + Sociodemographic Variables	6479001
Significant in Bivariate Only	5995675
Full Model	5995657

roughly 3% of the study participants were frequent ED users in each year, with a total of 4.33% incurring 4 or more ED visits in either year. Only 1.16% of Medicare beneficiaries were frequent ED users in both 2009 and 2010. In each study year, roughly 70% of the sample had no visits and approximately 1/4 of the sample had 1-3 visits. Over half of the sample (56.97%) never visited the ED during the study period, while 37.54% were infrequent ED users.

As presented in Table 12 (See Chapter 2, page 41), the majority of non-ED users in 2009 remained non-ED users in 2010 (78.43%), whereas 20.39% were characterized as infrequent ED users and 1.18% were characterized as frequent ED users in 2010. More than half of infrequent ED users in 2009 incurred no ED visits in 2010, 40.05% remained infrequent ED users and 6.19% were frequent ED users. Among frequent ED users in 2009, 20.90% incurred no ED visits in 2010, 42.05% incurred 1-3 ED visits, and 37.05%

remained frequent ED users in 2010, making them most likely to be frequent ED users in 2010 compared to the other ED user groups.

Baseline characteristics of the respective ED user groups are displayed in Table 18. There was a larger percentage of younger (less than 65 years of age), female, African-American, Medicaid-eligible, and disabled beneficiaries in the persistent frequent ED user category compared to non-, infrequent, and episodic frequent ED users. The average Continuity of Care Index was lowest while the number of physician visits and average HCC score was highest among persistent frequent ED users. The prevalence of CHF, heart disease, COPD, CKD, mental illness, diabetes, and arthritis was greatest in the persistent frequent ED user group. Hyperlipidemia was most common among infrequent ED users, whereas the rates of hypertension and dementia were highest among occasional frequent ED users. While most of the contextual-level variables were similar among the different ED user groups, persistent frequent ED users lived in PCSAs with the highest percentage of blacks and lowest median income. The results of bivariate logistic regression analyses, displayed in Table 19, confirm the findings of the descriptive analysis.

The results of the multivariate multinomial logistic regression are exhibited in Table 20. While most variables in our final, full model were statistically significantly associated with frequent ED use in 2010, the factors with the greatest relative risk ratios were frequent ED use in 2009, younger age, having 5 or more physician visits in 2010, heart disease, dementia, and mental illness. Frequent ED users in 2009 had a relative risk ratio of 23.86 (CI 23.28-24.46) for being frequent ED users versus non-ED users in 2010. Beneficiaries aged 18-34 had more than 6 times the relative risk of frequent ED use versus non-ED use in 2010 compared to beneficiaries aged 65-74 (RRR 6.39, CI 6.17-6.61). Those who visited the

Table 18: Baseline Statistics, Longitudinal Analysis*,†					
	Non-ED Users	**Infrequent ED Users**	**Occasional Frequent ED Users**	**Persistent Frequent ED Users**	**Total**
	n=2,954,995	n=1,946,927	n=224,381	n=60,220	n=5,186,523
	Percent	**Percent**	**Percent**	**Percent**	**Percent**
Total Sample	56.97	37.54	4.33	1.16	100.00
Sociodemographic Characteristics					
Age					
18-34	1.23	1.71	5.46	12.16	1.72
35-44	2.07	2.93	7.86	16.09	2.80
45-54	4.38	6.04	12.95	21.84	5.58
55-64	6.53	8.10	11.94	14.72	7.45
65-74	48.47	34.92	24.12	15.66	41.95
75-84	28.74	31.61	24.24	12.94	29.44
85+	8.59	14.70	13.42	6.59	11.07
Gender					
Male	45.85	42.22	41.11	39.00	44.20
Female	54.15	57.78	58.89	61.00	55.80
Race					
Caucasian	82.94	81.60	74.89	68.93	81.92
African-American	7.68	10.17	16.16	21.77	9.15
Asian/Pacific Islander	2.59	1.63	0.94	0.69	2.14
Hispanic	5.27	5.36	6.45	6.68	5.37
Native American	0.48	0.46	0.84	1.27	0.49
Other/Unknown	1.05	0.78	0.72	0.68	0.93
Medicaid Eligibility					
0 Months	85.67	77.46	56.62	32.23	80.71
1-12 Months	14.33	22.54	43.38	67.77	19.29

Table 18: Baseline Statistics, Longitudinal Analysis*,†					
	Non-ED Users	**Infrequent ED Users**	**Occasional Frequent ED Users**	**Persistent Frequent ED Users**	**Total**
Percent Elderly in PCSA, 2007 (Mean)	13.96	13.99	13.95	13.73	13.97
Percent Black in PCSA, 2007 (Mean)	11.32	11.95	12.60	13.52	11.64
Percent Hispanic in PCSA, 2007 (Mean)	12.02	11.38	10.84	10.20	11.71
Median Income in PCSA, 2007 (Mean)	$54,238	$53,276	$50,418	$48,863	$53,649
Primary Care Characteristics					
Continuity of Care Index, 2009 (Mean)	0.36	0.32	0.30	0.28	0.34
Continuity of Care Category, 2009					
No COC (<3 physician visits in 2009)	38.07	21.20	18.74	16.05	30.64
Low	18.68	27.01	30.39	34.86	22.50
Medium	14.44	21.29	22.12	22.08	17.43
High	28.82	30.49	28.75	27.01	29.42
Continuity of Care Index, 2010 (Mean, SD)	0.36	0.33	0.31	0.31	0.34
Continuity of Care Category, 2010					
No COC (<3 physician visits in 2009)	38.22	20.94	18.91	17.79	30.66
Low	19.48	27.31	30.03	32.10	23.03
Medium	13.92	20.59	21.23	20.82	16.82
High	28.38	31.16	29.82	29.29	29.49
Number of Physician Visits, 2009 (Mean, SD)	5.42	7.05	8.41	9.80	6.52
Fewer than 5 physician visits in 2009	56.68	35.90	30.24	25.91	47.38
5 or more physician visits in 2009	43.32	64.10	69.76	74.09	52.62
Number of Physician Visits, 2010 (Mean, SD)	5.43	7.05	8.37	9.58	6.52
Fewer than 5 physician visits in 2010	56.84	35.49	30.06	27.84	47.33
5 or more physician visits in 2010	43.16	64.51	69.94	72.16	52.67
Primary Care Physicians/1000 in PCSA, 2007 (Mean, SD)	0.76	0.76	0.74	0.75	0.76
Community Health Centers/1000 in PCSA, 2007 (Mean, SD)	0.05	0.06	0.07	0.07	0.06
Clinical Characteristics					

Table 18: Baseline Statistics, Longitudinal Analysis*,†					
	Non-ED Users	**Infrequent ED Users**	**Occasional Frequent ED Users**	**Persistent Frequent ED Users**	**Total**
Original Reason for Medicare Entitlement					
Aged	80.16	72.83	51.55	25.88	75.54
Disabled without ESRD	19.54	26.24	46.30	70.96	23.81
ESRD only	0.11	0.33	0.70	1.16	0.23
Disabed with ESRD	0.19	0.61	1.45	2.00	0.42
Chronic Disease Diagnoses					
Congestive Heart Failure					
No	96.19	83.19	76.84	75.81	90.24
Yes	3.81	16.81	23.16	24.19	9.76
Other Heart Disease					
No	68.26	36.38	27.72	22.36	54.01
Yes	31.74	63.62	72.28	77.64	45.99
Chronic Obstructive Pulmonary Disease					
No	91.93	78.67	69.27	59.32	85.59
Yes	8.07	21.33	30.73	40.68	14.41
Hyperlipidemia					
No	44.12	34.80	38.46	43.57	40.37
Yes	55.88	65.20	61.54	56.43	59.63
Hypertension					
No	41.79	22.37	21.32	24.40	33.41
Yes	58.21	77.63	78.68	75.60	66.59
Chronic Kidney Disease					
No	91.15	75.03	68.36	66.76	83.83
Yes	8.85	24.97	31.64	33.24	16.17
Mental Illness					
No	86.64	67.03	42.15	20.73	76.59

Table 18: Baseline Statistics, Longitudinal Analysis*,†					
	Non-ED Users	**Infrequent ED Users**	**Occasional Frequent ED Users**	**Persistent Frequent ED Users**	**Total**
Yes	13.36	32.97	57.85	79.27	23.41
Diabetes					
No	74.23	63.78	59.79	56.64	69.48
Yes	25.77	36.22	40.21	43.36	30.52
Dementia					
No	97.63	90.46	85.67	87.05	94.30
Yes	2.37	9.54	14.33	12.95	5.70
Arthritis					
No	68.18	48.89	38.33	29.99	59.20
Yes	31.82	51.11	61.67	70.01	40.80
HCC Score (Mean, SD)	0.81	1.18	1.47	1.74	0.99
ED Visit Rate in PCSA, 2005 (Mean, SD)	21.67	22.69	22.13	23.70	22.10
PCP Visit Rate in PCSA, 2005 (Mean, SD)	76.93	77.17	77.48	77.73	77.05
*All variables measured in 2009 unless otherwise specified †All differences statistically significant at the p=0.05 level					

Table 19: Bivariate Multinomial Logistic Regression Results, Longitudinal Analysis*						
	Frequent vs. Non-Users			Frequent vs. Infrequent Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
Frequent Use in 2009						
Non-User	1.00			1.00		
Infrequent User	7.68	7.59	7.79	2.68	2.65	2.72
Frequent User	118.29	115.82	120.81	15.29	15.02	15.56
Sociodemographic (Predisposing Characteristics)						
AGE						
18-34	11.81	11.50	12.12	5.70	5.56	5.85
35-44	9.63	9.39	9.87	4.65	4.54	4.76
45-54	6.96	6.81	7.11	3.55	3.47	3.62
55-64	3.96	3.88	4.05	2.26	2.22	2.31
65-74	1.00			1.00		
75-84	1.57	1.54	1.59	1.04	1.02	1.06
85+	2.64	2.58	2.70	1.16	1.14	1.19
GENDER						
Male	1.00			1.00		
Female	1.22	1.21	1.23	1.06	1.05	1.07
RACE						
White	1.00			1.00		
Black	2.48	2.41	2.56	1.79	1.75	1.84
Asian	0.40	0.37	0.43	0.61	0.58	0.65
Hispanic	1.38	1.31	1.45	1.29	1.22	1.36
Native American	2.29	2.05	2.56	2.20	2.07	2.33

Table 19: Bivariate Multinomial Logistic Regression Results, Longitudinal Analysis*						
	Frequent vs. Non-Users			Frequent vs. Infrequent Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
Unknown/Other	0.79	0.74	0.84	1.02	0.96	1.09
MEDICAID	5.34	5.19	5.50	3.06	2.99	3.12
% ELDERLY IN PCSA (Standardized)	0.98*	0.96	1.01	0.98	0.97	1.00
% BLACK IN PCSA (Standardized)	1.10	1.08	1.11	1.05	1.03	1.06
% HISPANIC IN PCSA (Standardized)	0.92	0.90	0.93	0.95	0.94	0.96
MEDIAN INCOME IN PCSA (Standardized)	0.76	0.74	0.77	0.80	0.79	0.81
Primary Care (Enabling Characteristics)						
CONTINUITY OF CARE, 2009						
High	1.00			1.00		
Medium	1.35	1.22	1.38	1.08	1.06	1.09
Low	1.49	1.46	1.52	1.20	1.18	1.22
None	0.58	0.57	0.59	0.94	0.92	0.96
CONTINUITY OF CARE, 2010						
High	1.00			1.00		
Medium	1.44	1.42	1.47	1.07	1.06	1.09
Low	1.53	1.51	1.55	1.20	1.18	1.22
None	0.46	0.45	0.47	0.96	0.94	0.98
PHYSICIAN VISITS, 2009						
Less than 5	1.00			1.00		
5 or More	2.37	2.34	2.41	1.26	1.25	1.28
PHYSICIAN VISITS, 2010						
Less than 5	1.00			1.00		
5 or More	3.17	3.11	3.23	1.27	1.25	1.29

Table 19: Bivariate Multinomial Logistic Regression Results, Longitudinal Analysis*						
	Frequent vs. Non-Users			Frequent vs. Infrequent Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
PCPS/1000 IN PCSA (Standardized)	0.95	0.93	0.98	0.96	0.95	0.98
CHCS/1000 IN PCSA (Standardized)	1.07	1.06	1.08	1.07	1.06	1.08
Clinical (Need Characteristics)						
MEDICARE ENTITLEMENT REASON						
Old Age	1.00			1.00		
Disability	4.52	4.44	4.59	3.00	2.95	3.04
ESRD	10.82	10.17	11.52	3.46	3.26	3.67
Disability and ESRD	11.79	11.28	12.33	3.50	3.35	3.66
HYPERLIPIDEMIA	1.14	1.12	1.15	0.81	0.80	0.82
HYPERTENTION	2.27	2.23	2.31	0.96	0.95	0.98
OTHER HEART DISEASE	5.11	5.03	5.20	1.49	1.47	1.51
CONGESTIVE HEART FAILURE	5.47	5.37	5.57	1.34	1.32	1.36
COPD	4.72	4.65	4.79	1.68	1.66	1.70
DEMENTIA	4.94	4.85	5.03	1.37	1.35	1.40
DIABETES	1.89	1.86	1.91	1.18	1.17	1.19
ARTHRITIS	3.43	3.39	3.48	1.62	1.60	1.64
MENTAL ILLNESS	9.24	9.11	9.38	3.19	3.14	3.23
CHRONIC KIDNEY DISEASE	3.93	3.88	3.98	1.29	1.28	1.31
HCC SCORE (Standardized)	1.86	1.85	1.87	1.17	1.17	1.18
PCP VISIT RATE IN PCSA, 2005 (Standardized)	1.07*	0.99	1.16	1.03*	1.00	1.06
ED VISIT RATE IN PCSA, 2005 (Standardized)	1.01	1.00	1.02	0.99	0.99	1.00

*Not Statistically Significant at .05 level

Table 20: Multivariate Multinomial Logistic Regression Results, Longitudinal Analysis						
	Frequent vs. Non-Users			Frequent vs. Infrequent Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
Frequent Use in 2009						
Non-User	1.00			1.00		
Infrequent User	3.03	2.99	3.08	1.97	1.95	2.00
Frequent User	23.86	23.28	24.46	7.62	7.48	7.76
Sociodemographic (Predisposing Characteristics)						
AGE						
18-34	6.39	6.17	6.61	2.94	2.84	3.04
35-44	4.00	3.87	4.12	2.23	2.16	2.29
45-54	2.43	2.37	2.49	1.70	1.66	1.74
55-64	1.40	1.36	1.43	1.23	1.20	1.26
65-74	1.00			1.00		
75-84	1.20	1.18	1.22	1.02	1.01	1.04
85+	1.63	1.60	1.67	1.09	1.07	1.12
GENDER						
Male	1.00			1.00		
Female	1.12	1.11	1.13	1.00*	0.99	1.02
RACE						
White	1.00			1.00		
Black	1.74	1.79	1.78	1.33	1.31	1.36
Asian	0.63	0.57	0.68	0.82	0.77	0.88
Hispanic	1.26	1.19	1.33	1.11	1.07	1.15
Native American	1.15	1.03	1.27	1.31	1.22	1.40
Unknown/Other	0.88	0.82	0.95	0.97	0.91	1.04
MEDICAID	1.65	1.60	1.69	1.38	1.36	1.40
% ELDERLY IN PCSA (Standardized)	0.95	0.93	0.97	0.97	0.96	0.99

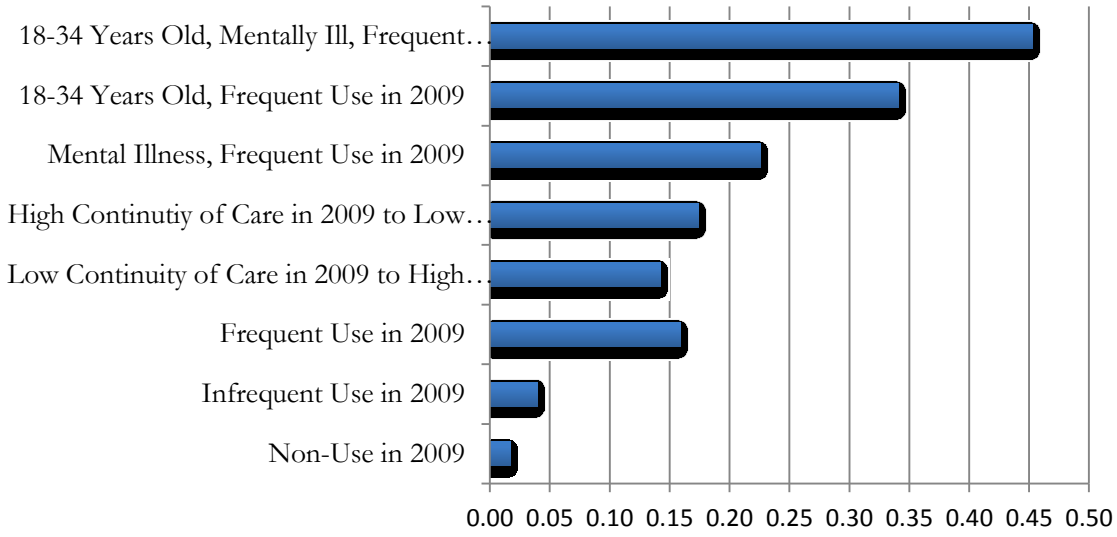
Table 20: Multivariate Multinomial Logistic Regression Results, Longitudinal Analysis						
	Frequent vs. Non-Users			Frequent vs. Infrequent Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
% BLACK IN PCSA (Standardized)	0.88	0.87	0.89	0.92	0.91	0.93
% HISPANIC IN PCSA (Standardized)	0.86	0.84	0.88	0.93	0.92	0.94
MEDIAN INCOME IN PCSA (Standardized)	0.86	0.85	0.88	0.90	0.88	0.91
Primary Care (Enabling Characteristics)						
CONTINUITY OF CARE, 2009						
High	1.00			1.00		
Medium	0.92	0.89	0.92	0.94	0.92	0.95
Low	0.89	0.88	0.91	0.94	0.92	0.95
None	1.51	1.47	1.54	1.19	1.16	1.21
CONTINUITY OF CARE, 2010						
High	1.00			1.00		
Medium	1.18	1.16	1.20	1.09	1.07	1.11
Low	1.45	1.42	1.47	1.25	1.23	1.27
None	0.82	0.80	0.84	1.03	1.01	1.06
PHYSICIAN VISITS, 2009						
Less than 5	1.00			1.00		
5 or More	0.72	0.71	0.73	0.90	0.89	0.92
PHYSICIAN VISITS, 2010						
Less than 5	1.00			1.00		
5 or More	2.03	1.99	2.07	1.34	1.32	1.37
PCPS/1000 IN PCSA (Standardized)	1.00*	0.98	1.01	1.00*	0.99	1.01
CHCS/1000 IN PCSA (Standardized)	1.06	1.05	1.07	1.04	1.03	1.05
Clinical (Need Characteristics)						
MEDICARE ENTITLEMENT REASON						
Old Age	1.00			1.00		

Table 20: Multivariate Multinomial Logistic Regression Results, Longitudinal Analysis						
	Frequent vs. Non-Users			Frequent vs. Infrequent Users		
	Odds Ratio	95% Wald Confidence Interval		Odds Ratio	95% Wald Confidence Interval	
Disability	1.45	1.42	1.49	1.20	1.18	1.22
ESRD	1.43	1.33	1.55	1.10	1.03	1.17
Disability and ESRD	1.33	1.26	1.41	1.04*	0.98	1.09
HYPERLIPIDEMIA	0.81	0.79	0.82	0.91	0.90	0.92
HYPERTENTION	1.41	1.29	1.43	1.05	1.03	1.07
OTHER HEART DISEASE	2.77	2.72	2.81	1.33	1.31	1.35
CONGESTIVE HEART FAILURE	1.67	1.64	1.70	1.04	1.03	1.06
COPD	1.73	1.71	1.76	1.16	1.14	1.17
DEMENTIA	2.78	2.72	2.84	1.30	1.28	1.32
DIABETES	1.09	1.07	1.10	1.02	1.00	1.03
ARTHRITIS	1.86	1.84	1.89	1.33	1.31	1.34
MENTAL ILLNESS	2.95	2.91	3.00	1.63	1.60	1.65
CHRONIC KIDNEY DISEASE	1.85	1.83	1.88	1.08	1.07	1.10
HCC SCORE (Standardized)	1.10	1.09	1.10	1.04	1.04	1.05
PCP VISIT RATE IN PCSA, 2005 (Standardized)	1.01	1.00	1.02	1.01*	1.00	1.01
ED VISIT RATE IN PCSA, 2005 (Standardized)	1.00*	0.99	1.01	0.99*	0.99	1.00

*Not Statistically Significant at .05 level

physician 5 or more times in 2010 were twice as likely to be frequent ED users versus non-ED users in 2010 (RRR 2.03, CI 1.99-2.07). Most chronic conditions in the model were associated with higher relative risk of frequent ED use in 2010, particularly heart disease

Figure 5: Probability of Frequent ED Use in 2010: Selected Results from Markov Analysis



Discussion

Young, mentally ill Medicare beneficiaries are the most vulnerable to frequent ED use. As previously reported in the general population, frequent ED use is a rare and temporary phenomenon in Medicare.[6,21] Only one-third of frequent ED users in one calendar year remain frequent ED users in the subsequent year, and persistent frequent ED users comprise approximately 1% of the FFS Medicare population. We found that persistent frequent ED users were disproportionately young, in racial minority groups, in worse health, Medicaid eligible, and heavy users of other healthcare services compared to non-ED users, infrequent ED users, and occasional frequent ED users. These results are consistent with previous cross-sectional studies on frequent ED use.[3,4,12] Medicare beneficiaries with mental illness in particular have a greater relative risk of frequent ED use,

which is also in accord with prior research in the general population.[12,21] While high continuity of care appears to be protective against frequent ED use in the concurrent year, continuity of care in the previous year has a small effect in the opposite direction. Frequent ED use in the prior year is the strongest factor associated with frequent ED use in the subsequent year.

The most striking finding of this research is the disproportionate probability of frequent ED use in the younger age groups. While a minority of Medicare beneficiaries, those under age 35 have the highest relative risks of frequent ED use in one year and over 2 years. The implication for the Medicare program is that to address frequent ED use specifically, it must dedicate more attention to its younger beneficiaries. Efforts to reduce frequent ED use in the Medicare population must therefore involve a wider range of healthcare providers that serve the small but fragile population of young, disabled Medicare enrollees.

In a 2008 survey by the Kaiser Family Foundation, disabled Medicare beneficiaries aged 64 and under reported more physician visits, ED visits, and hospitalizations than older beneficiaries, as well as greater rates of depression and lower rates of many recommended preventive services.[62] They also reported problems finding doctors who accept Medicare and obstacles to obtaining needed primary care, such as transportation barriers. These findings suggest that access to and quality of care may be challenges for this population that contribute to the observed high and persistent rates of frequent ED use.

Future research should examine risk factors among younger Medicare beneficiaries that are associated with heightened risk for ED use, such as where they seek medical care and what types of providers they see. This information would help direct efforts to educate and engage physicians that serve these beneficiaries. It is important that staff at community

health centers and other non-traditional Medicare providers understand and appropriately treat patients that may only represent a small portion of their panel but utilize a large portion of healthcare resources. Targeting young beneficiaries with mental illness and substance abuse issues will further concentrate efforts on the patients most likely to be frequent ED users.

More research is also needed to understand the acuity of ED visits by patient population. The real return on investment may not necessarily be in the younger frequent ED users if their visits are not resource-intensive. Rather, cost savings may be easier to accrue in the population of elderly frequent ED users who visit for exacerbations of chronic diseases and are more likely to be admitted to the hospital. While their visits are fewer, some evidence suggests that they are of higher triage status and may therefore represent a larger portion of Medicare expenditures.[56]

We acknowledge several limitations of this analysis. First, since claims are not collected for the purposes of research, we are unable to comment on services that were not reimbursed by the Medicare program. Our categorization of medical conditions is limited to those identified in administrative claims and is therefore a better reflection of treated rather than actual disease prevalence. We did not have access to patient-reported outcomes or clinical measures that could have offered a more complete understanding of why some beneficiaries are frequent ED users. Second, the retrospective nature of this analysis precludes us from making definite causal arguments. Third, with Medicare Advantage enrollees and deceased beneficiaries excluded, the generalizability of the findings is constrained to FFS beneficiaries who survived from 2008 to 2010.

Despite these limitations, this paper offers new insight and confirms previous findings relevant to Medicare beneficiaries and their providers. Frequent ED use, especially

persistent frequent ED use, is largely a reflection of poorly controlled chronic disease and mental illness, socioeconomic disparities, and to a lesser extent, a fragmented primary care system. A comprehensive, long-term strategy for reducing ED visits would address all of these risk factors, but in the meantime CMS can focus on learning more about its younger beneficiaries and how to appropriately treat their needs, particularly around mental illness.

Chapter 5: Discussion

Summary

This dissertation sought to understand the factors associated with frequent emergency department (ED) use in the Medicare population. I conducted a systematic review of peer-reviewed literature on the topic of frequent ED use as well as 2 original claims-based analyses - a cross-sectional examination of frequent ED use in 2010, and a longitudinal examination of frequent ED use from 2009-2010. The systematic review suggested 3 key areas warranting further research – frequent ED use by Medicare beneficiaries, primary-care level factors that may affect frequent ED use, and the persistence of frequent ED use over time. The 2 original studies attempted to address these gaps in the literature and contribute to the knowledge base of frequent ED use in a population highly likely to engage in this disruptive and costly pattern of healthcare utilization.

I applied the Andersen model of health service use to guide the selection of variables and construction of models to determine the factors associated with frequent ED use among Medicare beneficiaries. Predisposing characteristics included age, gender, race, and Medicaid eligibility at the individual level and the age, race, and income distribution of a beneficiary's primary care service area (PCSA) at the contextual level. Enabling resources included the number of and continuity of care across primary care visits at the individual level and the supply of physicians and community health centers at the contextual level. Need was characterized by Medicare entitlement reason, the presence of chronic physical and mental health conditions, and risk score at the beneficiary level and the rate of ED visits and physician office visits at the community level.

I found that frequent ED use is a relatively rare and temporary phenomenon in the Medicare population. Only 3% of beneficiaries will be a frequent ED user in a given year, and the majority of those who are frequent users in one year will return to non- or infrequent ED use in the subsequent year. Both the cross-sectional and longitudinal analysis revealed that while low continuity of care (COC) is associated with greater relative risk of frequent ED use, factors such as age, race, and chronic disease diagnoses have a stronger effect. Thus predisposing and need characteristics drive frequent ED use more so than enabling resources.

In the cross-sectional model predicting frequent ED use in 2010, after adjusting for all sociodemographic, primary care, and clinical factors, beneficiaries with low COC had a 26% higher relative risk than those with high COC of being frequent ED users compared to non-ED users. Younger beneficiaries were especially prone to frequent ED use, with 16 times the relative risk for 18-34 year-olds and more than 8 times the relative risk for 35-44 year-olds versus 65-74 year-olds. African-Americans and those who received Medicaid benefits were twice as likely to be frequent ED users compared to Whites and those without Medicaid, respectively. Several chronic conditions were associated with higher relative risk of frequent ED use versus non-ED use, particularly congestive heart failure (RRR 3.01, CI 2.95-3.07), other heart disease (RRR 5.21, CI 5.12-5.30), dementia (RRR 5.82, CI 5.68-5.98), mental illness (RRR 5.96, CI 5.86-6.07), and chronic kidney disease (RRR 3.32, CI 3.27-3.37). Each additional standard deviation increase in physician visits amplified the relative risk of frequent ED use by 29%, demonstrating that frequent ED users are frequent users of healthcare services across the board.

The longitudinal model predicting frequent ED use in 2010 based on 2009 ED use and controlling for socio-demographic, primary care, and clinical factors produced similar

results to the cross-sectional analysis. While the effects of COC in 2009 were attenuated, low COC in 2010 was associated with a 45% greater relative risk of frequent ED use versus non-ED use in 2010. Younger age, African-American race, Medicaid enrollment, other heart disease, dementia, and mental illness were most strongly correlated with frequent ED use. Although having 5+physician visits in 2009 was not highly associated with subsequent year frequent ED use, beneficiaries with 5 or more physician visits in 2010 were twice as likely to be frequent ED users in the concurrent year, again suggesting a general pattern of high healthcare utilization among frequent ED users.

Conclusions and Recommendations

The results of this dissertation suggest 3 main implications for the Medicare program and its administrating agency, The Centers for Medicare and Medicaid Services (CMS). First of all, Medicare policymakers and practitioners should further investigate and seek to improve overall treatment of disabled beneficiaries under age 65 so as to reduce ED visits in this population. Secondly, as chronic diseases are a major driver of frequent ED use, effective prevention and management of these conditions is essential. Finally, Medicare, like other health systems, needs to focus on improving the treatment of mental illness.

Disabled Medicare Beneficiaries

Our study is consistent with prior evidence indicating care of disabled beneficiaries under age 65 presents a major challenge for the Medicare program.[62] There were approximately 8 million such beneficiaries in 2010.[62] Social Security Disability Insurance (SSDI) beneficiaries become eligible for Medicare after 24 months of enrollment, as do their dependents. Disabled workers comprise approximately 86% of Medicare beneficiaries under age 65, while the remaining 14% are dependent spouses or children.[63] Approximately 1 in 6

SSDI recipients also qualify for Supplemental Security Income (SSI) and are thus eligible for Medicaid.[63] The growth of the under 65 population in Medicare far exceeds that of older adults.[63] Unfortunately, almost all disabled Medicare recipients remain in the program until they turn 65 and qualify based on old age.[63]

Compared to older beneficiaries, disabled Medicare enrollees are more likely to be male, a member of a racial minority group, have annual incomes less than $10,000, describe their health as fair or poor, have higher levels of activity limitation, and have cognitive impairment or mental illness.[62] A greater percentage of disabled beneficiaries report trouble getting health care that they needed or wanted – 13% versus 3% of elderly beneficiaries aged 65-74, 3% of those aged 75 and older, and 4.4% national average in 2008.[62] Similar results were found for delaying medical care because of cost concerns or not seeing a doctor when needed – 24% of the under 65 disabled compared to 2-7% for elderly Medicare enrollees and a national average of 8.4% in 2008; 19% of the under 65 disabled compared to 5-7% for elderly Medicare enrollees and a national average of 8.3% in 2008.[62]

The most common reasons for work disability among this population are mental disorders, followed by musculoskeletal diseases and mental retardation.[63] Disabled beneficiaries have higher average medical costs and greater utilization of physician office visits and ED visits than their elderly counterparts.[63] They are less likely to have Medigap plans and more likely to have Medicaid.[63]Disabled beneficiaries have higher average medical costs and greater utilization of physician office visits and ED visits than their elderly counterparts.[63]

While several CMS initiatives are underway that target elderly beneficiaries and those dually eligible for Medicare and Medicaid, as well as those with end-stage renal disease (ESRD), no current programs specifically target younger, disabled beneficiaries.[64] The

Administration for Community Living (ACL) is a sister agency under Health and Human Services (HHS) that is tasked with promoting programs to improve the health and independence of the disabled.[65] CMS should partner with ACL to launch pilot programs and other efforts to address the needs of disabled Medicare beneficiaries and prevent ED visits and hospitalizations in this vulnerable population. CMS's role as a payer could facilitate financial payments to motivate prevention efforts by providers whereas ACL could provide access to wraparound services such as transportation to strengthen the continuum of care for disabled Medicare enrollees.

Chronic Disease

Chronic disease is a public health problem affecting all major healthcare systems, and the Medicare population is especially susceptible to its clinical and financial consequences.[66] There has been no shortage of proposed interventions to improve the treatment of chronic diseases, but not all of these programs have proven to be cost-effective. Some of the more promising interventions such as the patient-centered medical home (PCMH), accountable care organizations (ACOs), and community-based wellness programs, have been embraced by CMS for pilot programs and demonstrations.[64] Many of the health care innovation awards (HCIA) also focus on preventing and managing chronic disease, and the success of some programs may provide justification for more widespread initiatives. If any of these efforts are to thrive, however it will require CMS to be flexible in how it pays providers and what types of providers it covers. For instance, CMS may need to compensate physicians for communication and care coordination with other physicians or employ case managers and community health workers if these innovations prove to be effective in reducing the clinical and financial burden of chronic disease.

Mental Illness

Finally, Medicare must do more for beneficiaries with mental illness and substance abuse. Mental illness and substance abuse are inadequately treated in American adults, leading to excessive reliance on EDs and hospitals.[67] When the Mental Health Parity Act took effect in 2010, Medicare began phasing in payments for mental health services to equal those of general health services, a process that will be complete in 2014.[68] The effect of this policy change has yet to be studied, thus a longitudinal analysis up to an including the 2014 calendar year when the full payment change takes effect will be essential.

While CMS is currently testing a model for managing psychiatric emergencies in the Medicaid population, it has no counterpart initiative for Medicare beneficiaries. A few of the HCIA sites are testing mental health innovations for Medicare and Medicaid beneficiaries, but otherwise there are no large-scale projects underway to address the burden of mental illness among Medicare beneficiaries. CMS needs to make a more concerted effort to test models for preventing and managing mental illness and substance abuse in Medicare, and to incorporate the mentally ill into current initiatives like the PCMH and ACOs.

Though PCPs are often in the best position to identify and manage moderate depression, and even recognize early warning signs of serious mental illness (SMI) like schizophrenia and severe depression or bipolar disorder, and substance abuse (SA).[69] However PCPs are not necessarily the ideal providers for treatment of SMI and SA, due to lack of training and resources. People with SMI and SA generally receive care through community-based mental health clinics, which are often unable to address physical health problems such as chronic disease.[69] Additionally, the recent trend toward managed behavioral health organizations (MBHOs) has separated the treatment of physical and mental health conditions.[69]

Croghan and Brown (2010) suggest that integrating mental health into the PCMH requires changes in the primary care practice as well as the site of mental health services, if different than the primary care practice.[69] Firstly, mental health must be normalized in the training and culture of physicians. Second, payment models need to be updated to encourage more integration between managed behavioral health organizations (MBHOs) and primary care practices. Finally, PCPs must be equipped with diagnostic, screening and monitoring tools to identify and manage mental health conditions and resources to make appropriate referrals.

As for ACOs, the current CMS regulations only have two quality measures related to mental health - depression screening and documentation of a follow-up plan. While other measures such as patient/physician communication and patient satisfaction may serve those with mental illness well, there are no explicit incentives for coordinating care beyond diagnosis for depression or for screening and treatment of SMI and SA.[70] O'Donnell and colleagues (2011) consider this lack of regulation on managing mental illness a "missed opportunity" for ACOs, considering the high rate of hospitalization and subsequent high costs among the mentally ill.[70] They suggest exploring several payment models beyond FFS that may encourage coordinated care for mental illness. These include the FFS plus management and performance fees, the Prometheus-Evidence Informed Case Rate Model, the Risk-Adjusted Comprehensive Payment and Bonus Model, bundled payments, pay-for-performance, and gain-sharing.[70] O'Donnell et al. also note that more start-up funding is needed to support the necessary primary care redesign to incorporate mental health care.[70] As with PCMH, there are several organizational options for integrating primary care and mental health care from reimbursing for care coordination between primary care and

specialty care, including mental health care to co-location of mental health providers in primary care settings and vice-versa.

Methodological Challenges

There are three main areas of limitations to this study that are important to acknowledge, one related to the use of claims data, the second having to do with the sample criteria, and the last third related to the retrospective design. First of all, there are some inherent challenges to relying exclusively on claims data. Medicare claims are a rich source of information on a large population that is clinically vulnerable and costly. In using a 20% from the Chronic Condition Data Warehouse, I benefited from a robust sample size and a wide array of socio-demographic and healthcare utilization variables. However, claims data are collected for billing rather than research purposes, thus the conclusions one can draw are only as sound as the data is reliably recorded. Human error and even intentional miscoding can lead to false inferences. Furthermore, while I can observe patterns in utilization such as frequent ED visits, I cannot elicit the true reason for an ED visit without patient-reported data or in-depth chart review. Additionally, I was only able to detect chronic diseases specifically reported in claims. Patient surveys, while subject to recall and response biases, would provide a better indication of the true prevalence of a disease beyond the claims-based estimates.

The sample criteria were another source of potential bias. In order to have complete medical records for the entire study period, I excluded beneficiaries with managed care, incomplete Parts A and B coverage, and those who died during the study time frame. Individual Medicare Advantage plans own managed care claims data. Beneficiaries with managed care represented 24% of Medicare beneficiaries in 2010, and their socio-

demographic, clinical and utilization profile may have differed from those in traditional fee-for-service (FFS) Medicare.[52] Beneficiaries with lapses in Parts A and B coverage or who died during the study period may also differ from beneficiaries included in the study in ways that can affect frequent ED use. Additionally, beneficiaries who died during the study period were presumably sicker than beneficiaries who remained in the sample, introducing a possible healthy users bias.

Finally, the design of this study, while having several strengths in terms of simplicity and comprehensiveness, nonetheless limited the ability to determine causality. Since the analysis was retrospective in nature I cannot make definitive causal inferences. A prospective study with propensity score matching of beneficiaries based on the independent variables of interest would be better suited to make causal determinations. While such a study design was not possible for this dissertation due to the lag in claims data, new efforts by the CCW to increase the availability and timeliness of claims data will allow future research to employ a more methodologically ideal prospective design.

Directions for Future Research

This dissertation provides a useful contribution to the current literature on frequent ED use and suggests several avenues for further exploration. I did not seek to differentiate among patterns of frequent ED use beyond the presence of 4 or more visits in a calendar year. Prior studies have suggested some possible patterns that may be relevant in the design of interventions to reduce frequent ED use. For instance, Blank and colleagues found that patients with 4-11 visits in a calendar year were more likely to be elderly and had a greater chance of being admitted to the hospital, whereas those with 12 or more visits were younger and less likely even than low frequency users to be admitted. Ruger and colleagues observed

a similar trend, in which those with 3-20 ED visits were more likely to be admitted to the hospital and those with more than 20 visits were more likely to be lower acuity patients who did not require hospitalization.[5] Future research on frequent ED use in Medicare should study the subpopulation of frequent ED users to differentiate among patterns of visits.

Analyzing trends in reported or admitting diagnoses was also beyond the scope of this project. Previous research has demonstrated mixed results with respect to the acuity of ED visits for frequent versus infrequent users.[3] Mandelberg et al. observed that frequent ED users at a San Francisco hospital had a greater relative risk of being in lower triage priority groups, whereas Kirby and colleagues as well as Fuda and Immeckus found the opposite to be true.[6,19] Fuda and Immeckus observed that mental health diagnoses were far more common among Medicaid recipients and Medicare enrollees younger than 65, whereas older Medicare beneficiaries were more likely to visit the ED due to exacerbations of chronic disease. It may be the case that elderly men and women visit the ED more often for exacerbation of chronic disease whereas younger patients tend to go to the ED for lower-acuity mental health stabilization. Further examination of the subpopulation of frequent ED users in Medicare would inform strategies to target interventions accordingly.

A final pattern in frequent ED use that is worth additional study is the number of facilities used. Pines and colleagues suggested as much in their expert consensus. [24] For instance, Fuda and Immeckus found that patients who attended the ED for mental health, substance abuse, and generic pain complaints visited a greater number of unique EDs, a finding echoed by Cook and colleagues.[6,18] Presentation to several EDs may imply drug-seeking behavior, which is consistent with mental health and substance abuse disorders and suggests a different kind of intervention than one geared toward chronically ill beneficiaries that primarily use one ED. This issue again warrants a more in-depth examination of

frequent ED users to study relevant clinical and utilization patterns beyond the frequent ED use.

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EDUCATION

Johns Hopkins Bloomberg School of Public Health **Baltimore, MD**

PhD Candidate, Health Services Research and Policy 2009-present

UCLA School of Public Affairs **Los Angeles, CA**

Master of Public Policy, Health and Aging Policy Concentration 2007

University of Pennsylvania **Philadelphia, PA**

Bachelor of Arts, Sociology and Political Science 2001

EXPERIENCE

Student Trainee **Baltimore, MD**

Centers for Medicare and Medicaid Services *2010-present*

-I am a Contract Officer Representative (COR) for the Retrospective Evaluation of Community-Based Wellness Programs. I oversee the statistical analysis of claims data to assess cost and utilization outcomes for Medicare beneficiaries that have participated in wellness programs.

-I am developing an evaluation plan to analyze the quality and performance of End-Stage Renal Disease (ESRD) Seamless Care Organizations in the Comprehensive ESRD Care Initiative. The evaluation will include a survey of beneficiaries, interviews with nephrologists and dialysis providers, and secondary analysis of clinical and claims data.

-I work with a panel of Health Care Innovation Awardees to design self-monitoring plans and select appropriate standardized measures to assess improvement in quality, health, and costs for Medicare and Medicaid patients. I will also be a COR for the independent evaluation of the impact of HCIA initiatives focused on chronic disease management.

-I am conducting intramural research on factors associated with frequent emergency department (ED) use in the Medicare population using the Chronic Condition Data Warehouse (CCW).

-I represent CMS at quarterly meetings of the Self-Management Alliance, a partnership of government, non-profit organizations and representatives from the healthcare industry dedicated to promoting self-management programs for chronic disease.

Teaching Assistant **Baltimore, MD**

Johns Hopkins Bloomberg School of Public Health *2011-2012*

I assisted professors with developing lecture material and graded assignments for Managed Care and Health Insurance (Winter 2011 and 2012) and Introduction to Health Policy (Fall 2011). I also taught a discussion lab and graded assignments for undergraduate students in Fundamentals of Health Policy and Management (Winter-Spring 2011 and 2012)

Research Assistant **Washington, DC**

AcademyHealth *Summer 2010*

I conducted literature reviews, attended and synthesized findings from site visits, and assisted with manuscript preparation for a project on health information technology and its potential for health services research.

Research Assistant **Baltimore, MD**

Johns Hopkins Bloomberg School of Public Health *2009-2010*

I conducted literature reviews and data analysis and prepared manuscripts for the Cancer Prevention and Treatment Demonstration (CPTD), a project exploring the effect of a patient navigation intervention on cancer screening in African-American Medicare beneficiaries.

Research Assistant **Washington, D.C.**

RAND Corporation *2007-2009*

I assisted Principal Investigators with research and analysis pertaining to a variety of health topics, including consumer directed health plans for older adults, health literacy, health disparities, vaccinations, Medicare payment policy, and public health emergency preparedness.

Teaching Assistant **Los Angeles, CA**

UCLA School of Public Affairs *2006-2007*

I assisted professors with developing lecture materials and graded assignments for Crime Control Policy (Spring 2007), California Policy Issues (Winter 2007) and Introduction to Public Policy (Fall 2006).

Tutor **Los Angeles, CA**

UCLA Academic Advancement Program *2006-2007*

I assisted students with writing assignments, helping them organize their ideas and checking for grammatical and style issues. I also trained students on public speaking, including developing arguments and delivering effective presentations. Additionally, I tutored students in courses on Ancient Greece and Rome.

Government Affairs Intern **Long Beach, CA**

SCAN® Health Plan *Summer 2006*

I conducted research into federal and state legislation on health and aging. I also developed materials on health policy legislation and the legislative process for employees and members.

Personal Care Planner **Long Beach, CA**

SCAN® Health Plan *2005-2006*

I conducted home visits and assessments for elderly beneficiaries enrolled in a Medicare Advantage (MA) plan. I also arranged personal care, homemaker, and emergency response services for homebound senior citizens. Additionally, I made referrals to community resources, and submitted reports of abuse and neglect to Adult Protective Services.

Field Organizer **Los Angeles, CA**

Campaign for Mental Health *June-November 2004*

I mobilized mental health agencies and advocates in the Los Angeles area for Proposition 63, a ballot initiative to expand mental health care in California. I also spoke to community groups about Proposition 63 and raised funds.

Intake and Information Specialist **Philadelphia, PA**

Philadelphia Corporation for Aging *2003-2004*

I fielded informational calls from senior citizens, families, and social workers and assisted with applications to PCA's long term-care programs. I also made referrals to community resources for the elderly and triaged reports of elderly abuse and neglect.

Health Benefits Specialist **Philadelphia, PA**

Health Federation of Philadelphia *2002-2003*

I assisted senior citizens in finding and applying for health care and other government benefits. I also followed up with clients and made referrals to community resources. Additionally, I supervised senior outreach volunteers.

Research Assistant **Philadelphia, PA**

University of Pennsylvania – Population Studies Center *2000-2001*

I conducted research for the Racial and Neighborhood Disparities in Infant Health study. I also edited subject interviews, entered data, and revised questionnaires.

SKILLS

Computing Skills

Statistical Packages: STATA, SAS

Qualitative Analysis Software: ATLAS.ti

Data sets

Chronic Condition Data Warehouse, National Health Interview Survey, Medical Expenditure Panel Survey, Behavioral Risk Factor Surveillance Survey, California Health Interview Survey, National Assessment of Adult Literacy.

PUBLICATIONS

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